US010787853B2

(12) **United States Patent**
Wolf et al.

(10) **Patent No.: US 10,787,853 B2**
(45) **Date of Patent: Sep. 29, 2020**

(54) **INTEGRATED CASEMENT WINDOW OPERATOR AND LOCK WITH ANTI-BACKDRIVE FEATURE**

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(73) Assignee: **Truth Hardware Corporation**, Owatonna, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 199 days.

(21) Appl. No.: **16/108,078**

(22) Filed: **Aug. 21, 2018**

(65) **Prior Publication Data**

US 2019/0063135 A1 Feb. 28, 2019

Related U.S. Application Data

(60) Provisional application No. 62/548,260, filed on Aug. 21, 2017, provisional application No. 62/660,135, filed on Apr. 19, 2018.

(51) **Int. Cl.**
E05F 11/24 (2006.01)
E05F 11/14 (2006.01)

(52) **U.S. Cl.**
CPC ***E05F 11/145*** (2013.01); ***E05F 11/14*** (2013.01); *E05Y 2800/116* (2013.01); *E05Y 2900/148* (2013.01)

(58) **Field of Classification Search**
CPC E05F 11/145; E05F 11/14; E05F 11/10; E05Y 2800/116; E05Y 2800/148;
(Continued)

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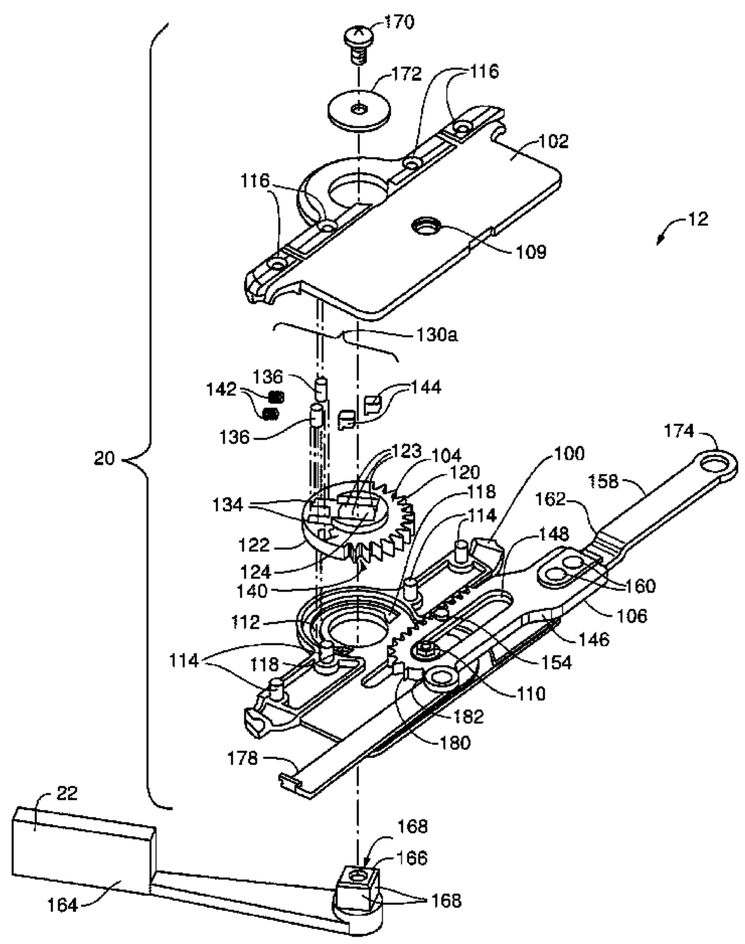
Primary Examiner — Jerry E Redman
(74) *Attorney, Agent, or Firm* — Bradley J. Thorson

(57) **ABSTRACT**

An integrated casement window operator and lock, including a gear mechanism and an arm assembly, the arm defining a rack portion and an adjacent arcuate gear portion, the arm mounted to the housing with a pinion gear engaged with the rack portion and the arcuate gear portion, the pinion gear defining a star-shaped aperture therethrough and a handle with a square-shaped shaft portion received in the star-shaped aperture of the gear. The handle is selectively rotatable to shift the arm between a window fully closed position and a window fully open position, wherein an anti-backdrive mechanism is provided to inhibit backdriving of the arm in both the window fully closed window fully open positions.

20 Claims, 24 Drawing Sheets



(58) **Field of Classification Search**
CPC ... E05C 1/12; E05C 9/12; E05C 9/021; E05C 9/041
USPC 49/248, 339, 341, 342
See application file for complete search history.

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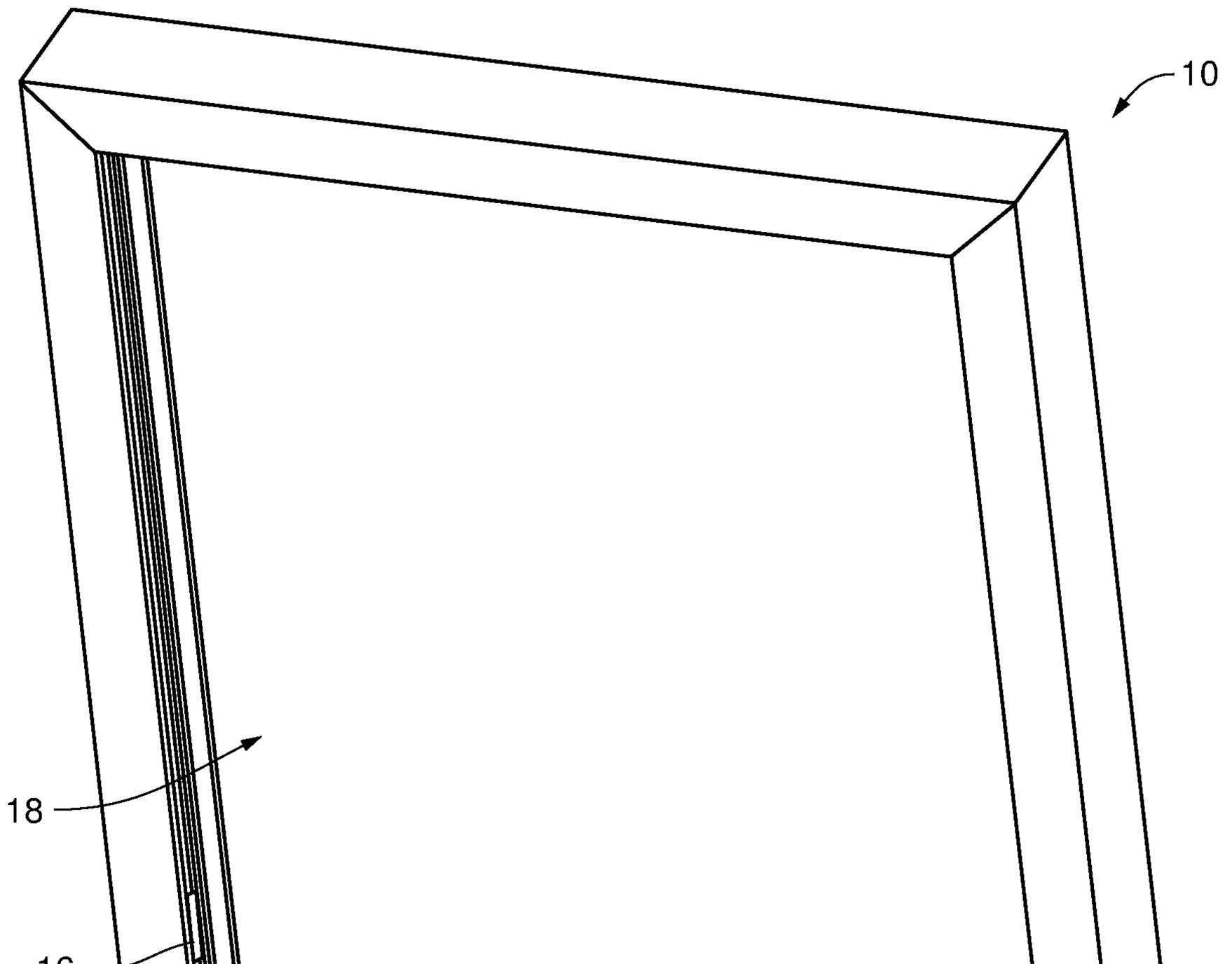

FIG. 1a

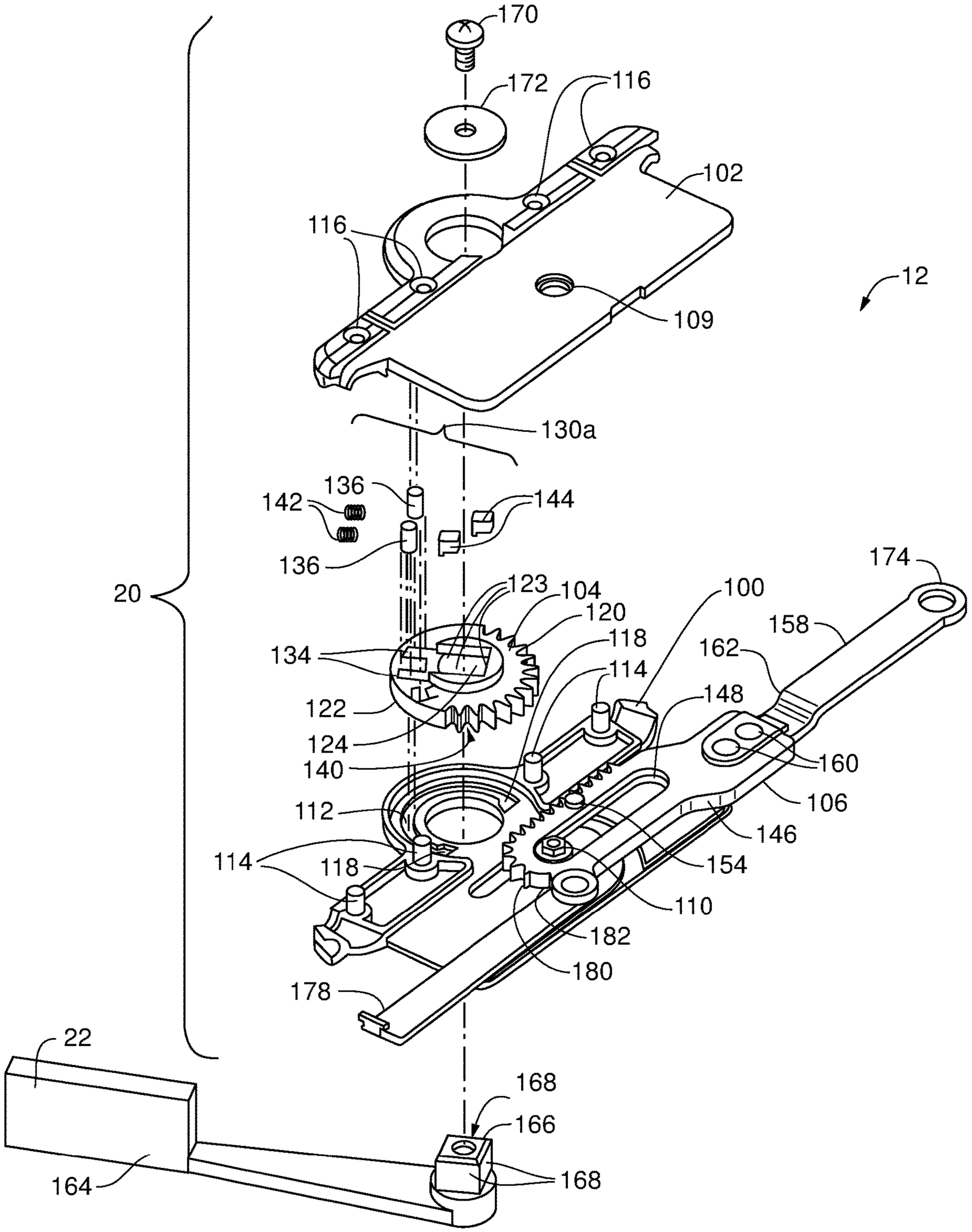
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FIG. 1

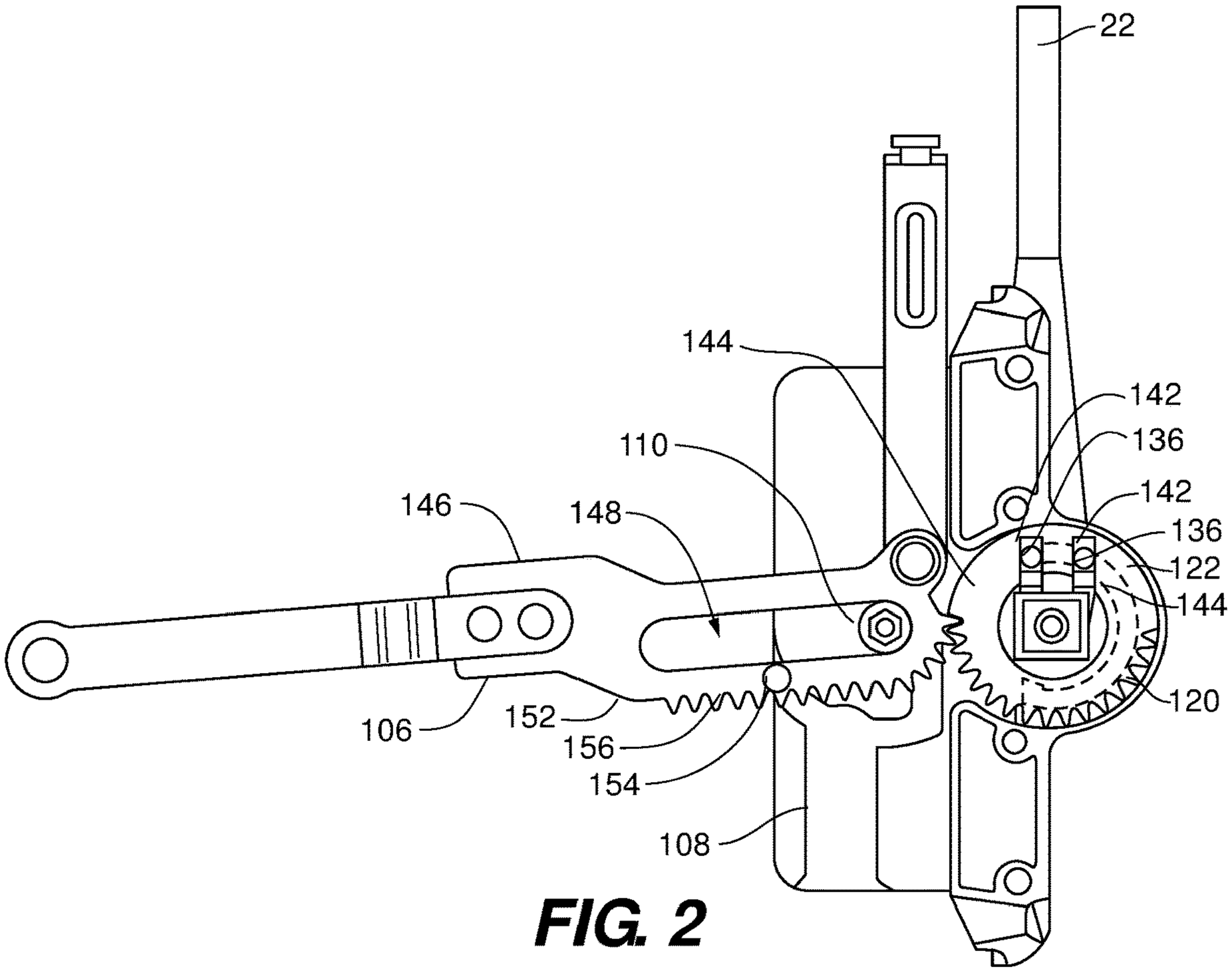
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FIG. 2

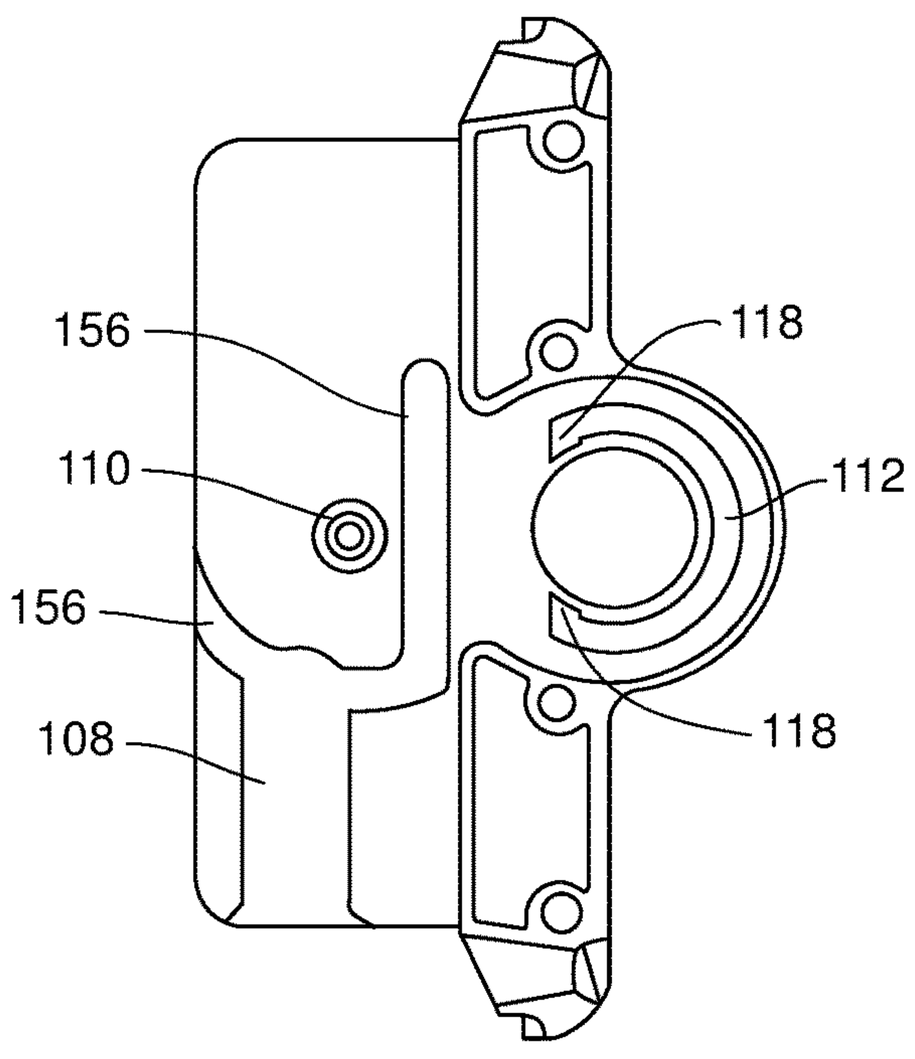
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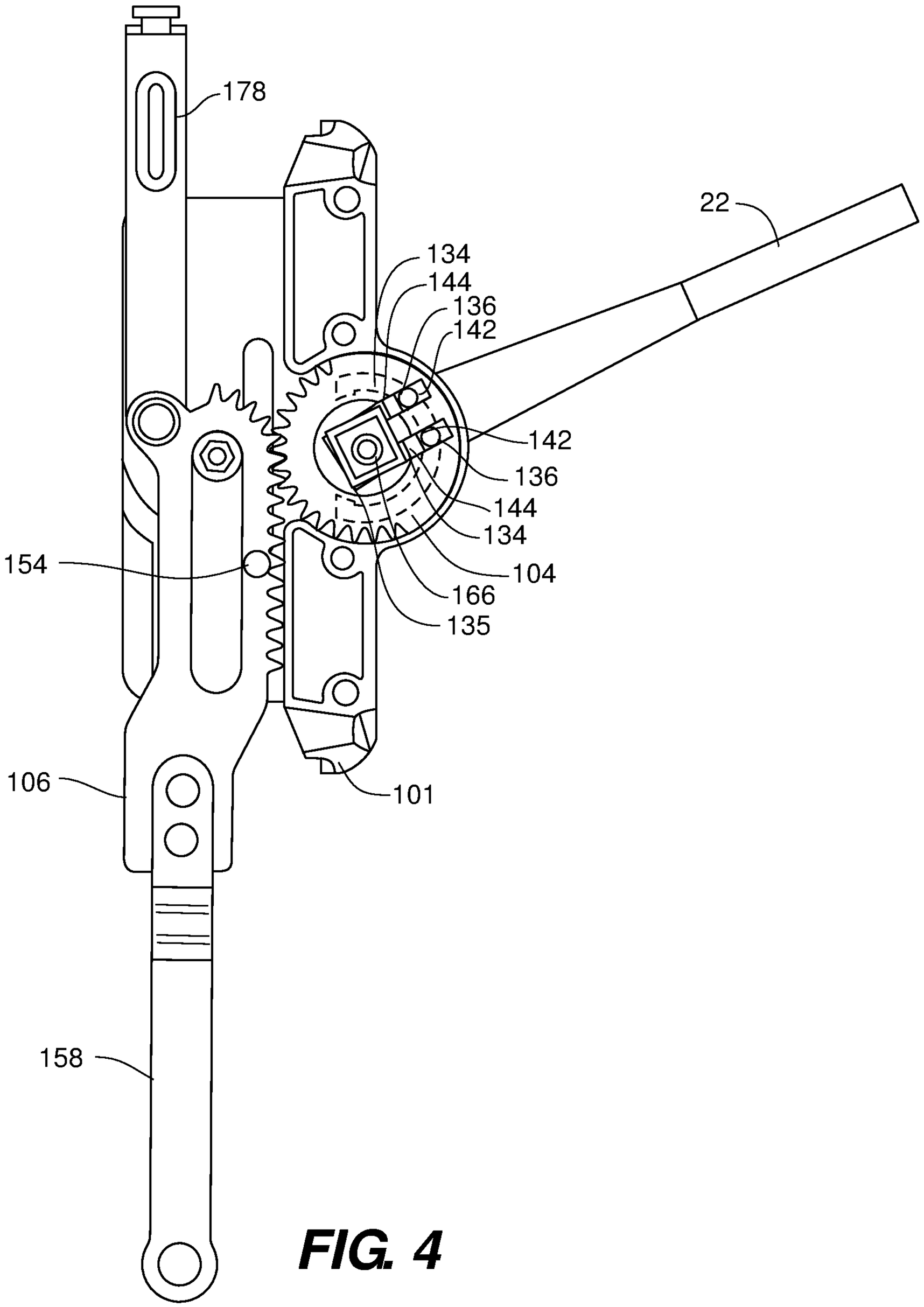
FIG. 3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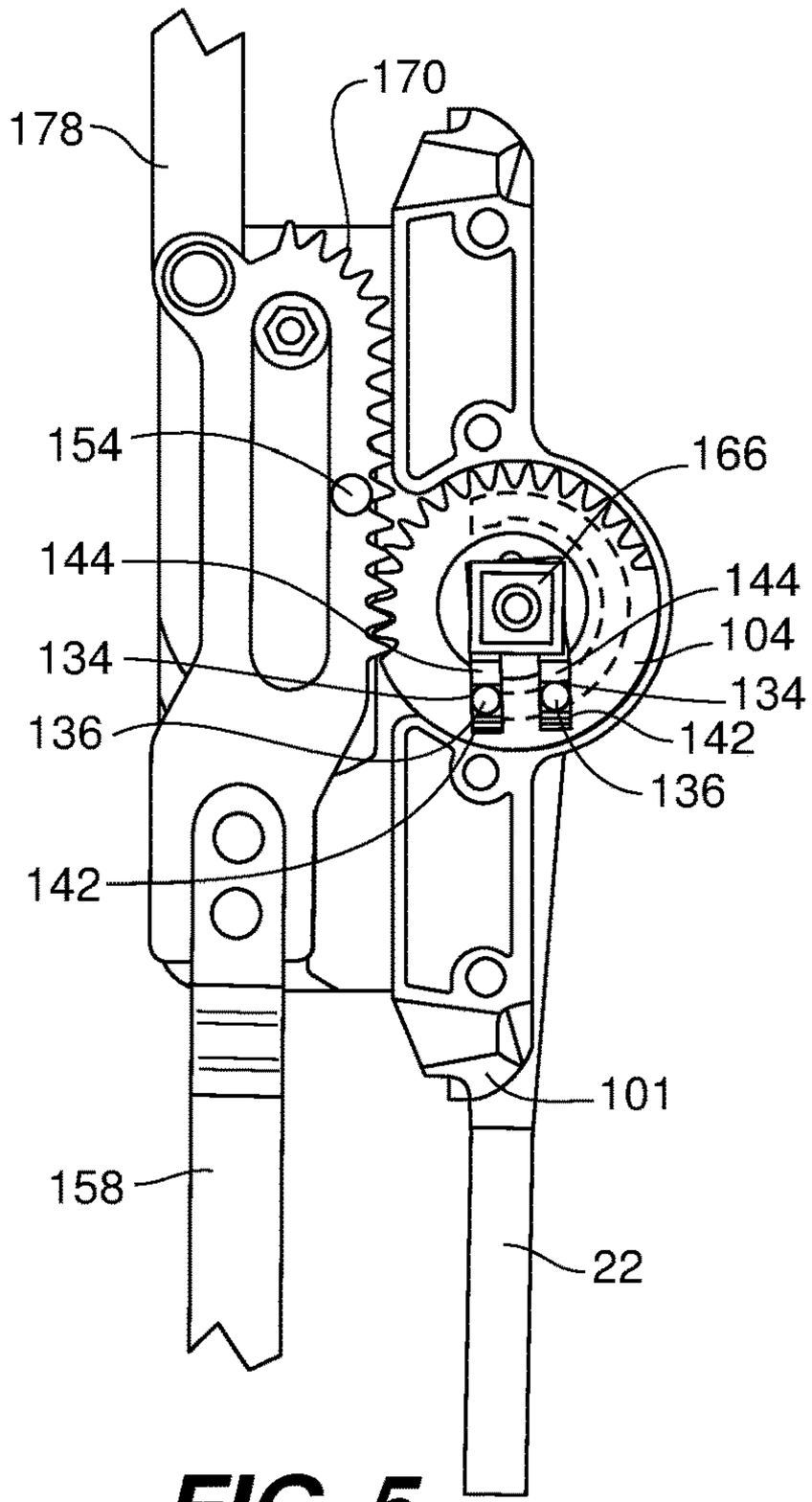
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FIG. 5

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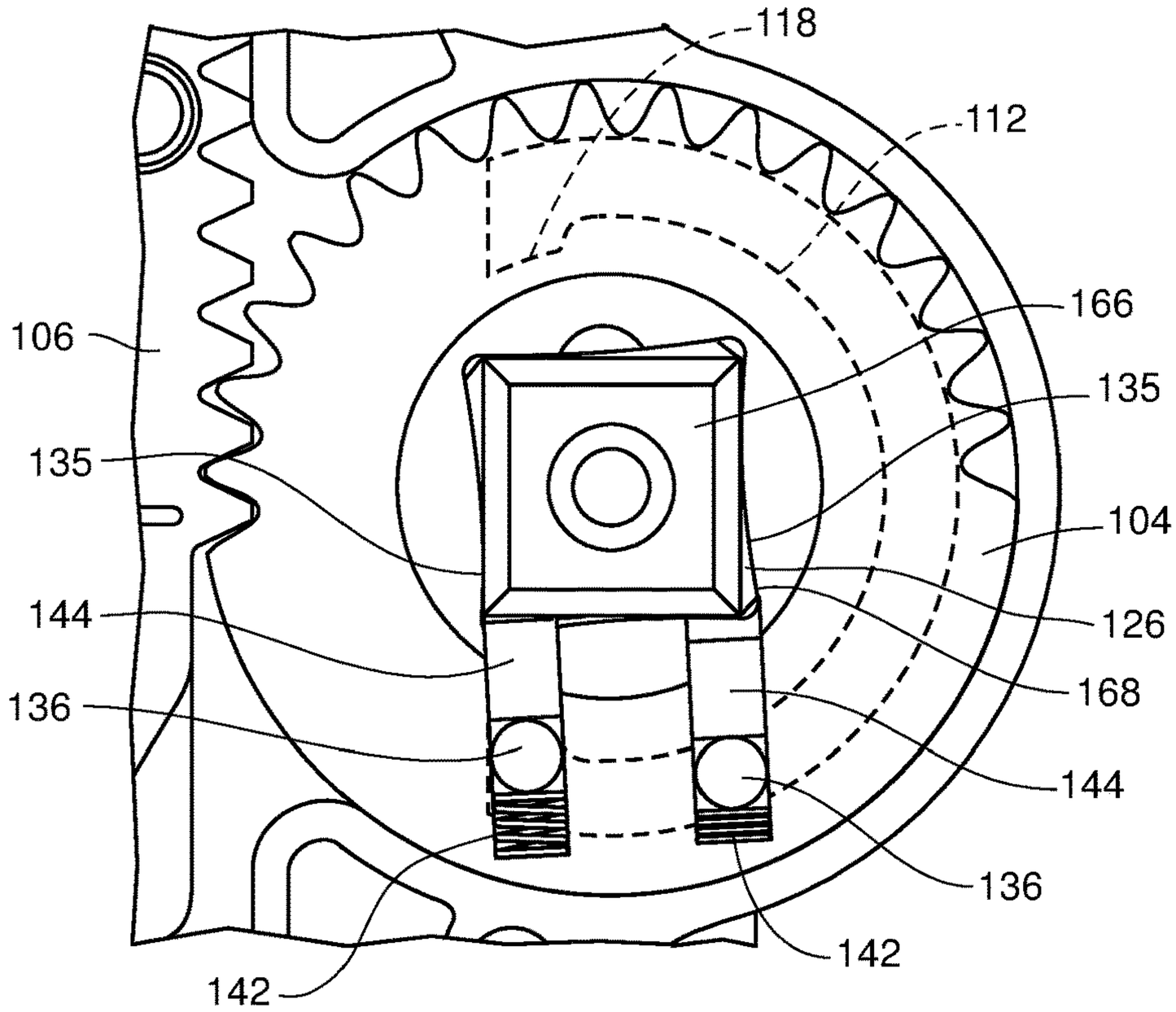
FIG. 6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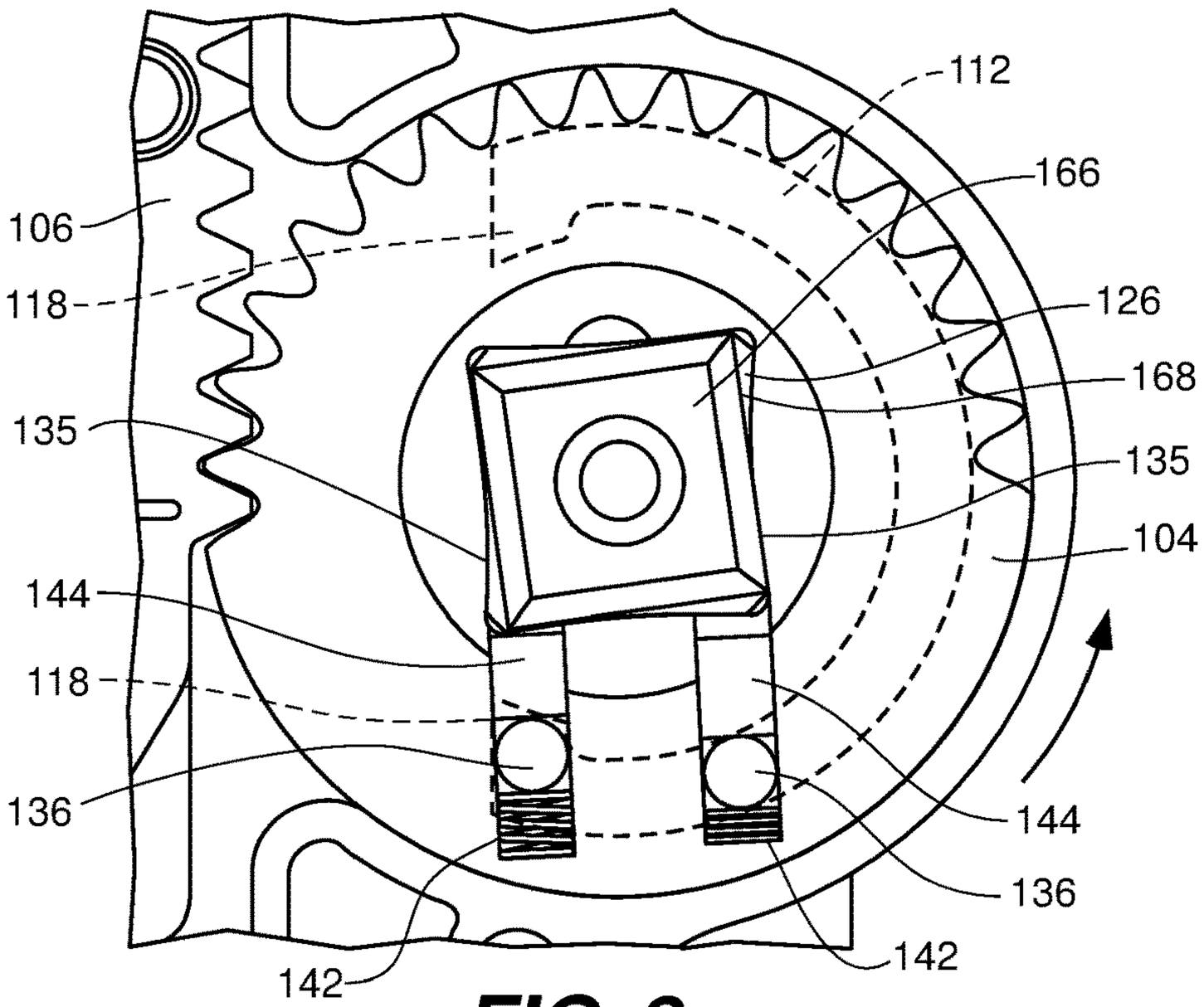
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FIG. 8

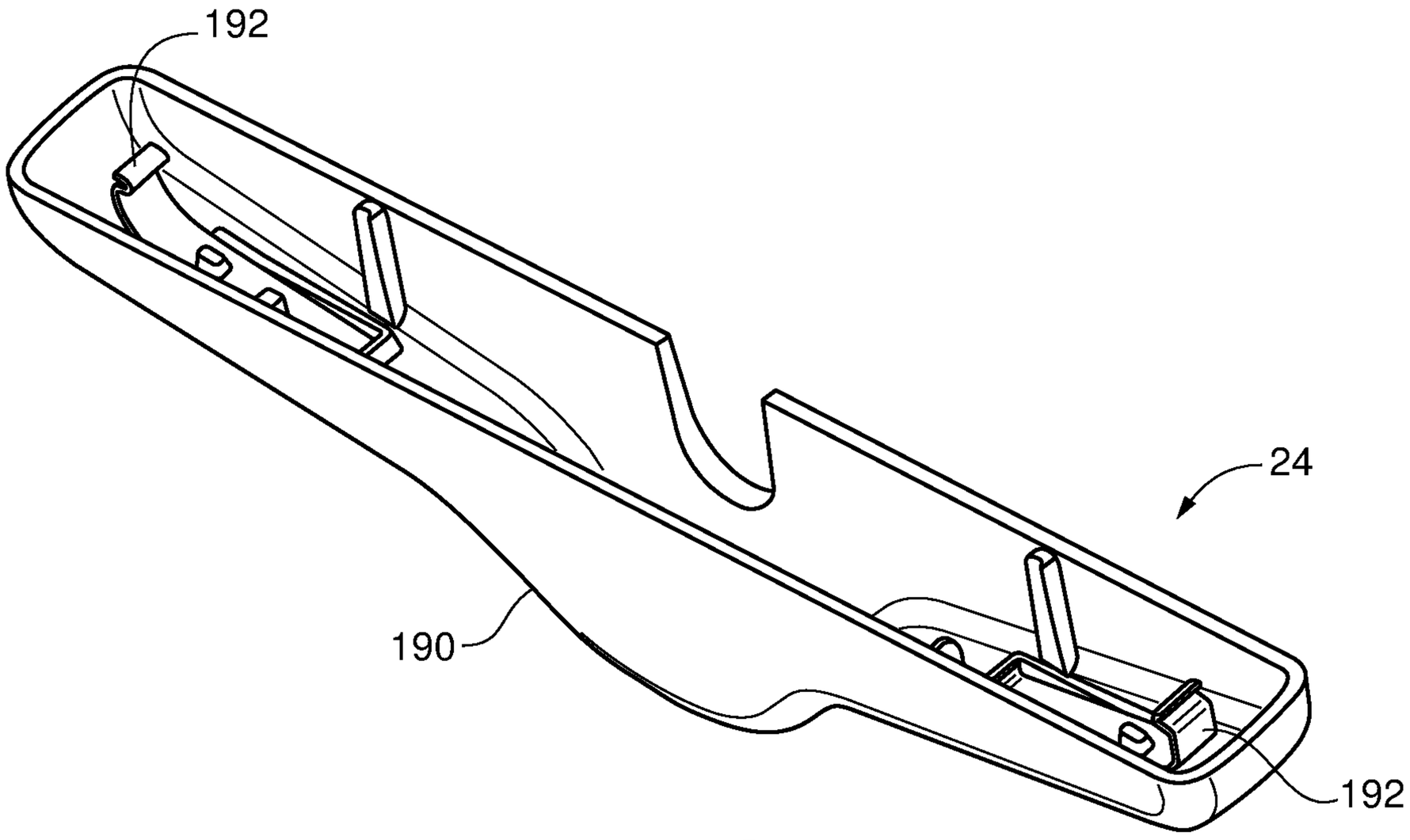
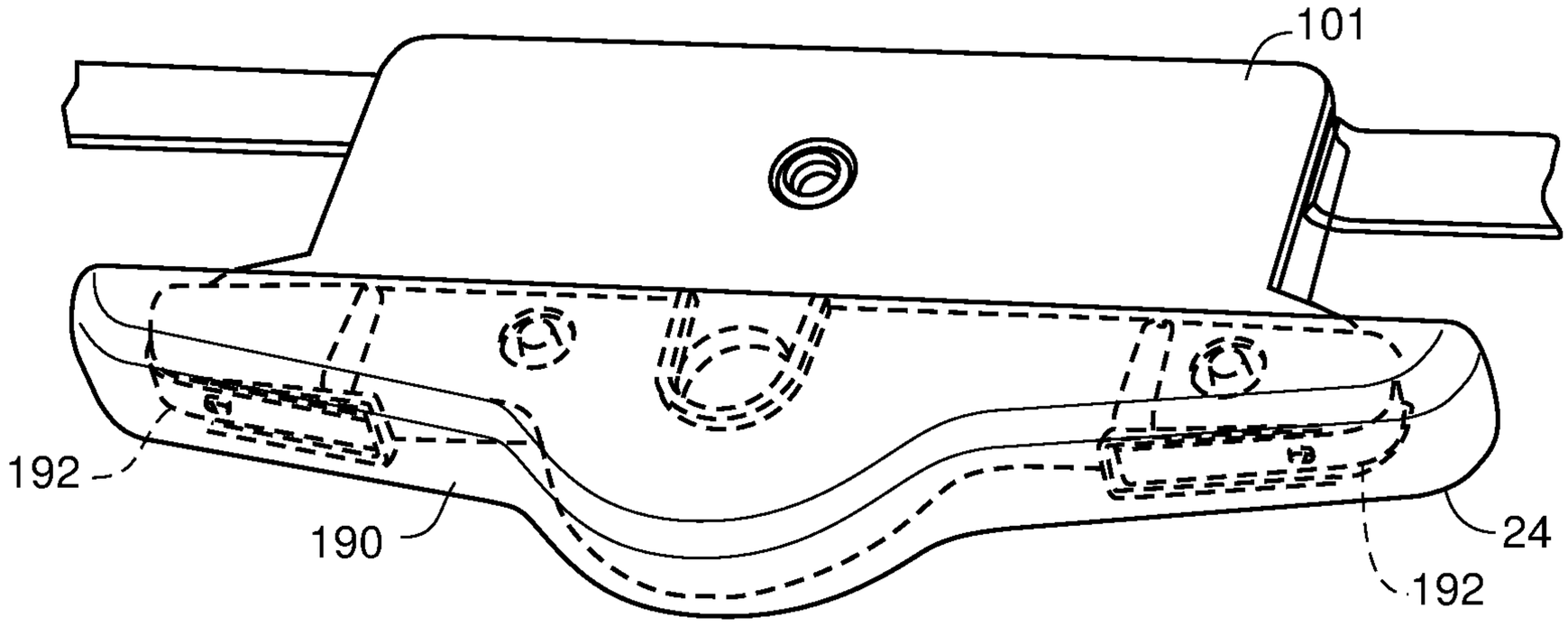


FIG. 9

FIG. 10



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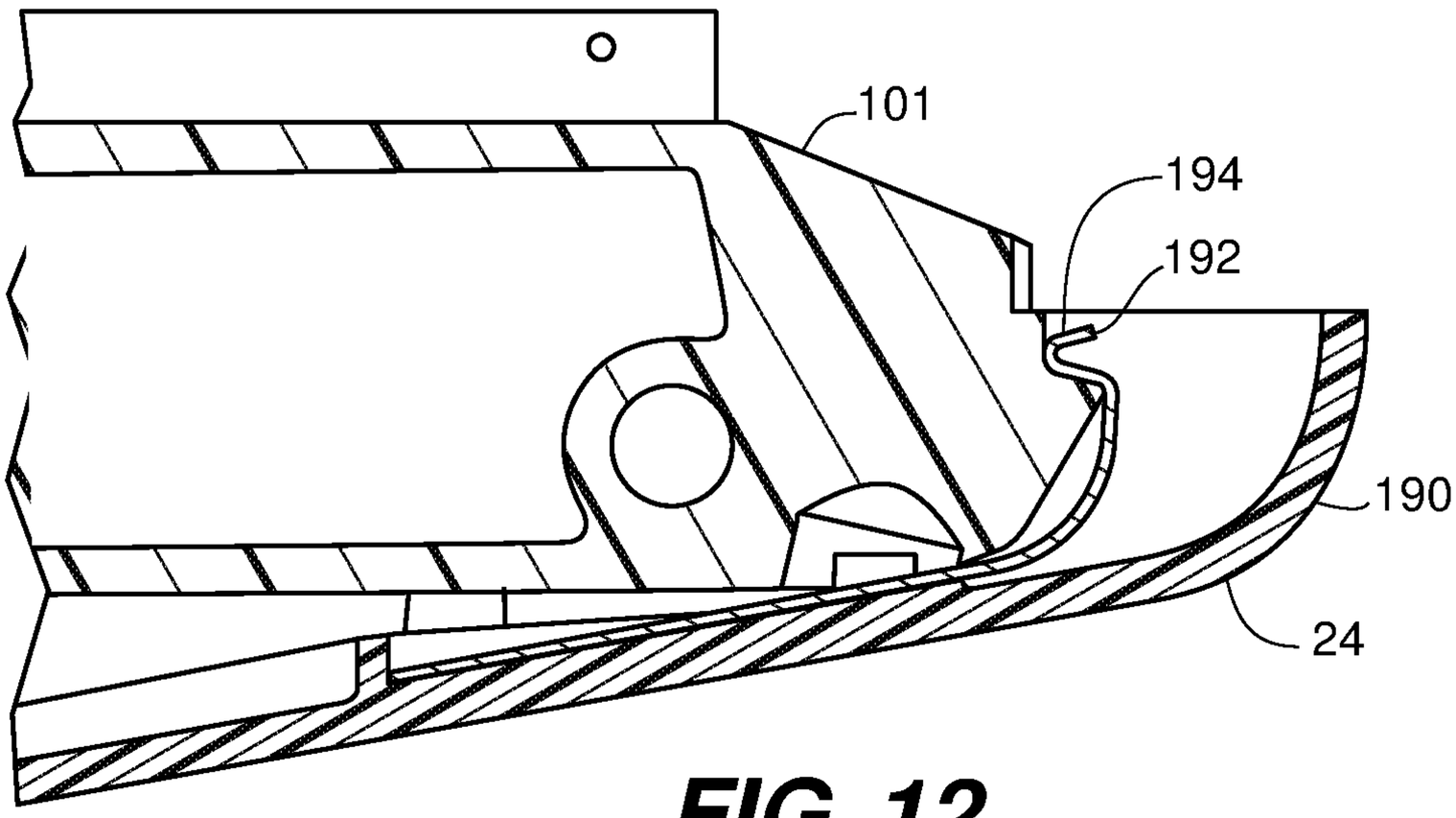

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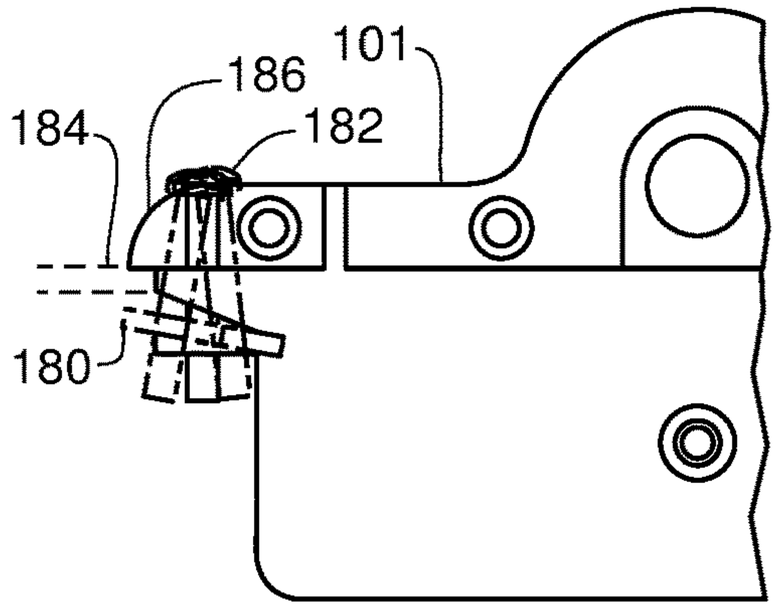

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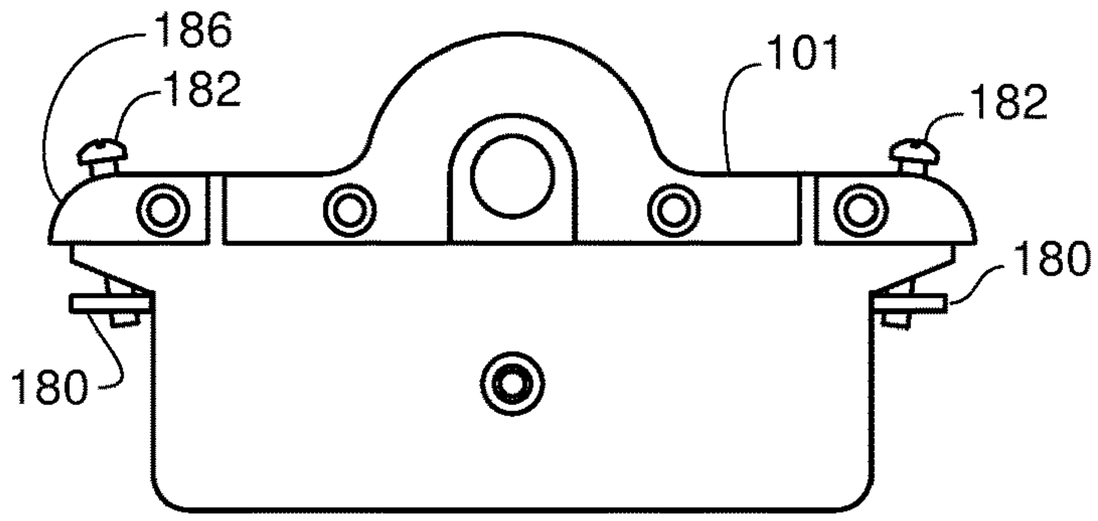

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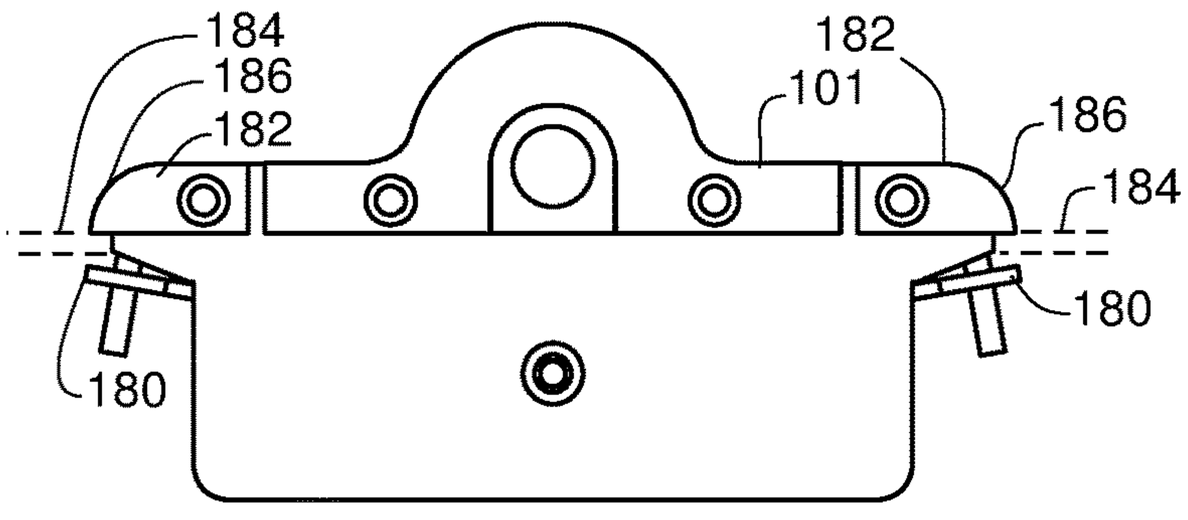

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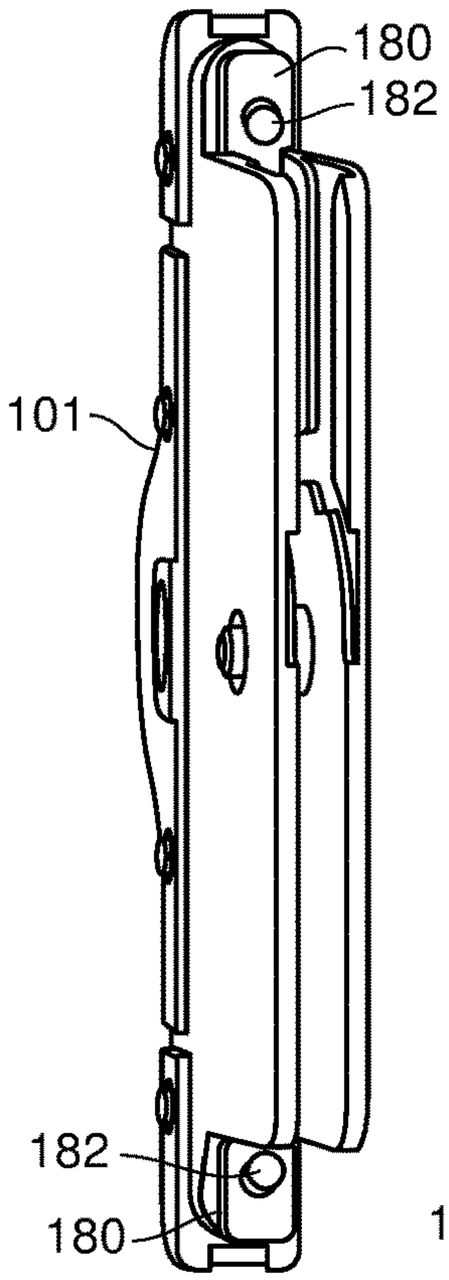

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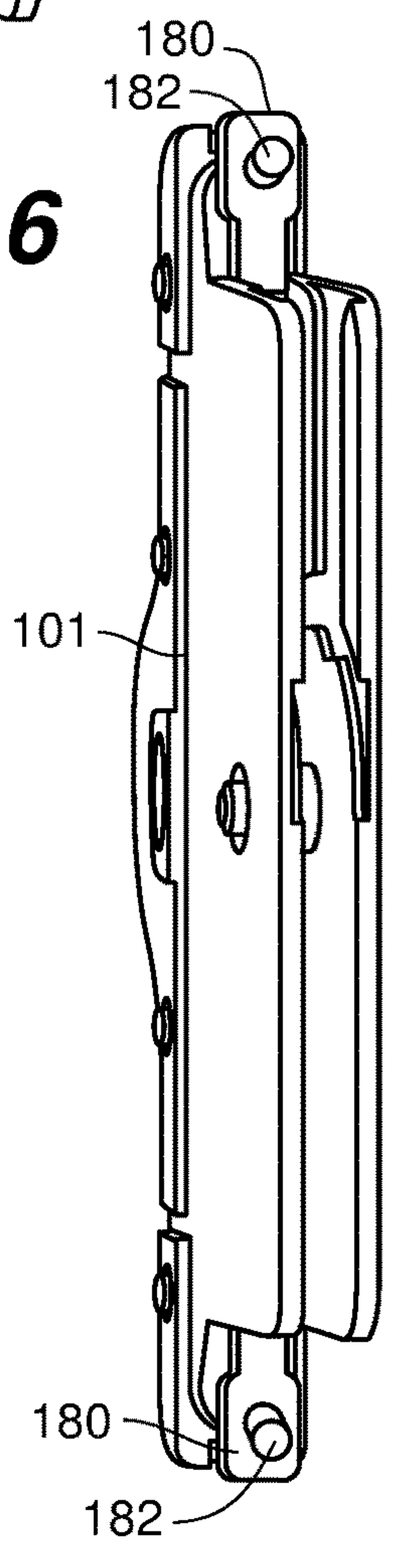

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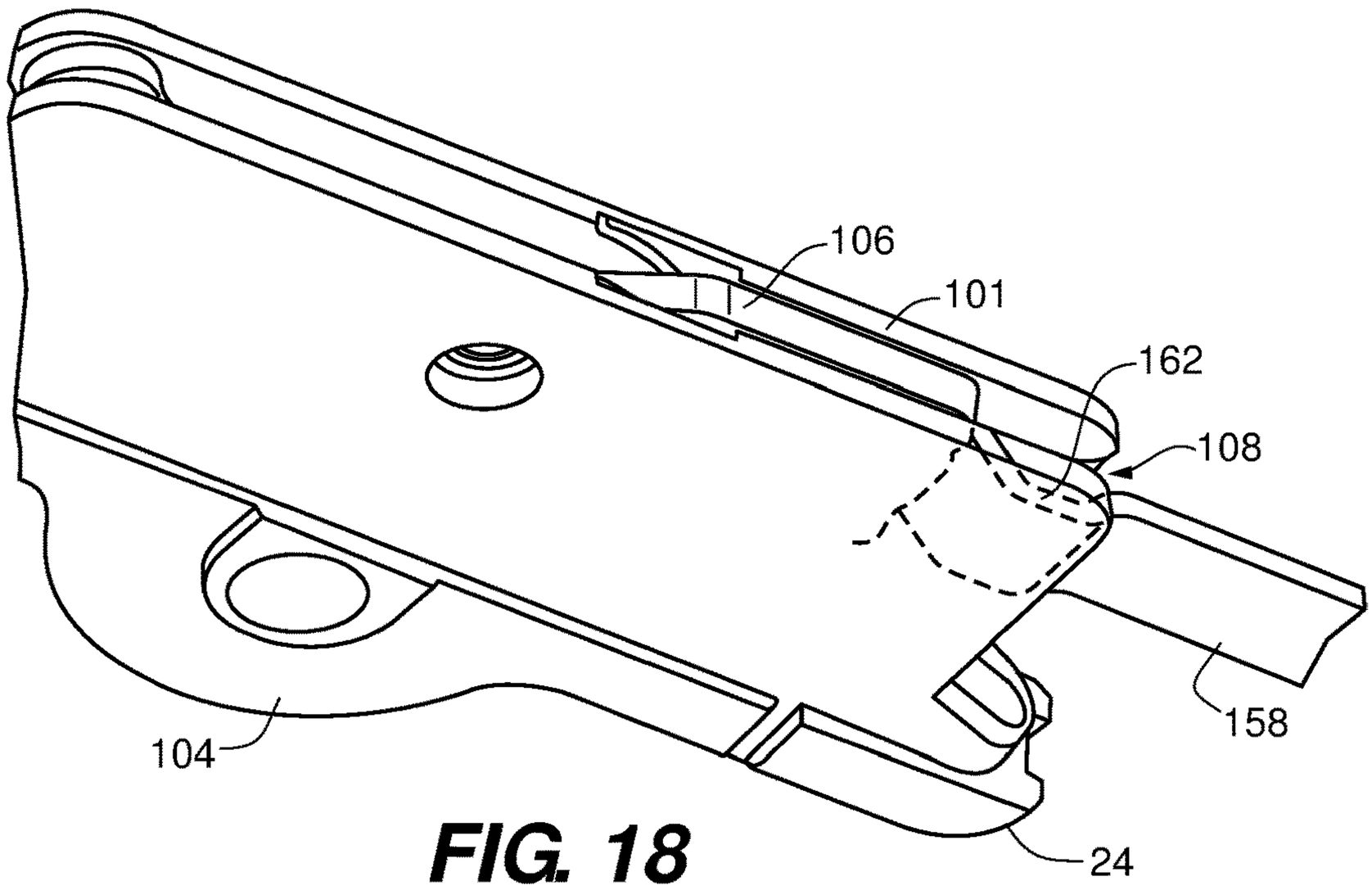

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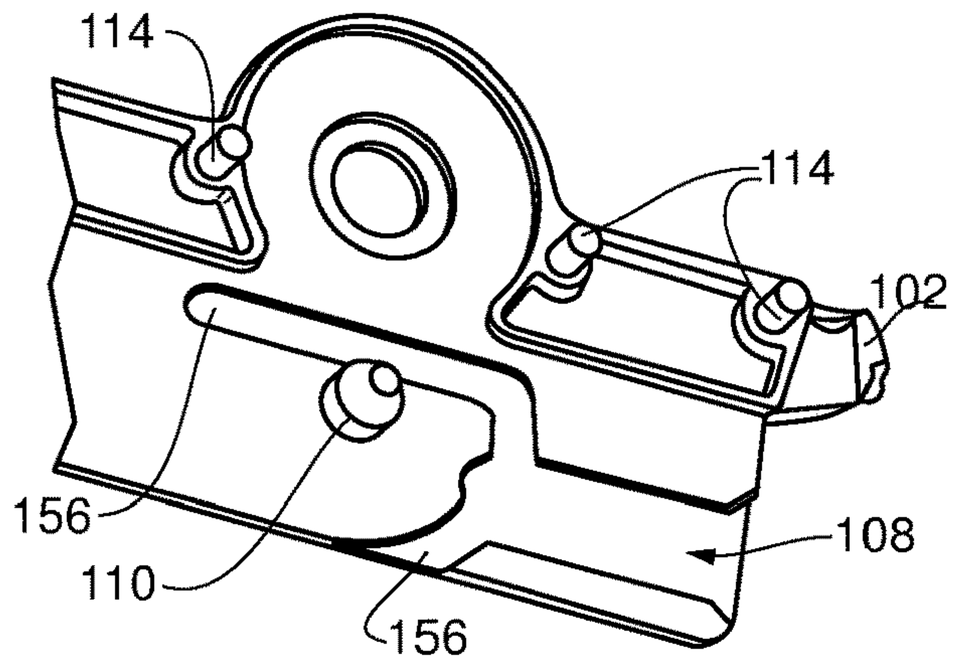

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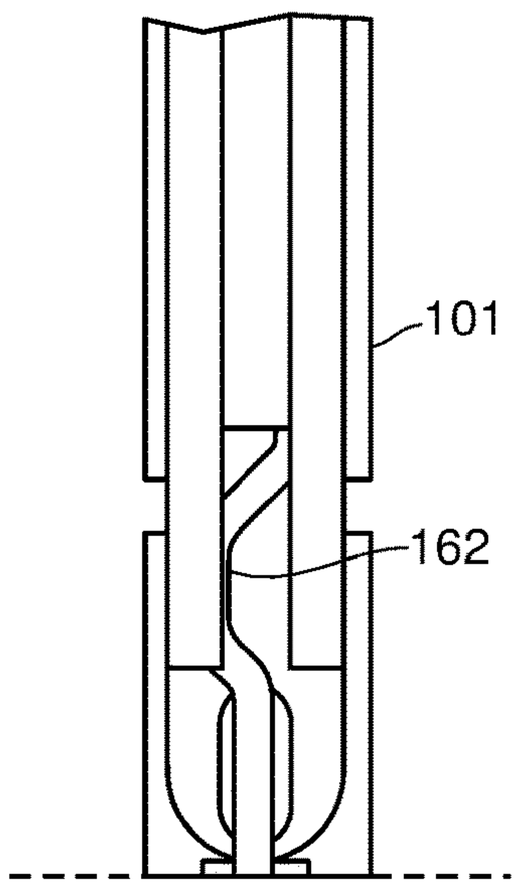

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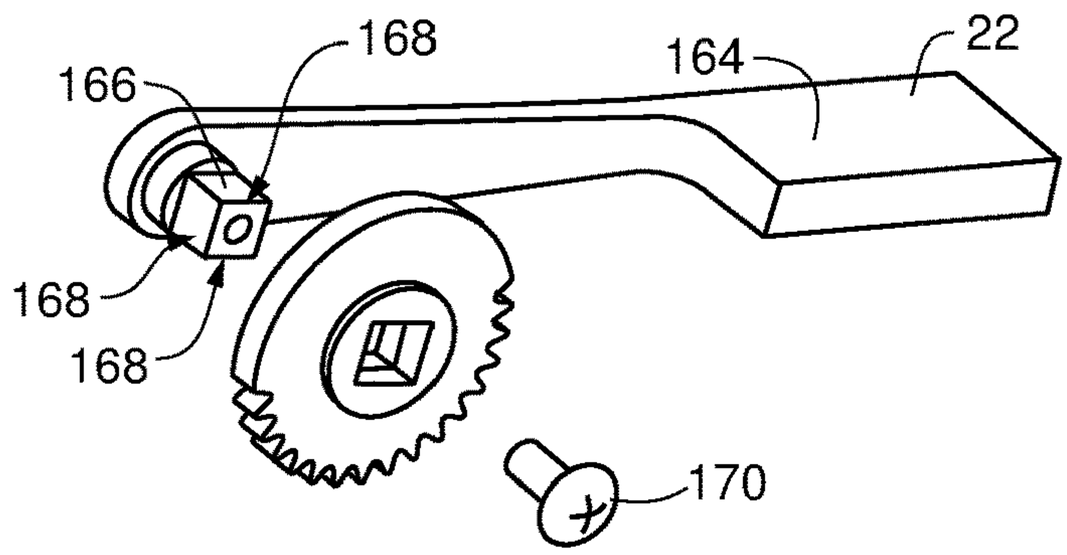

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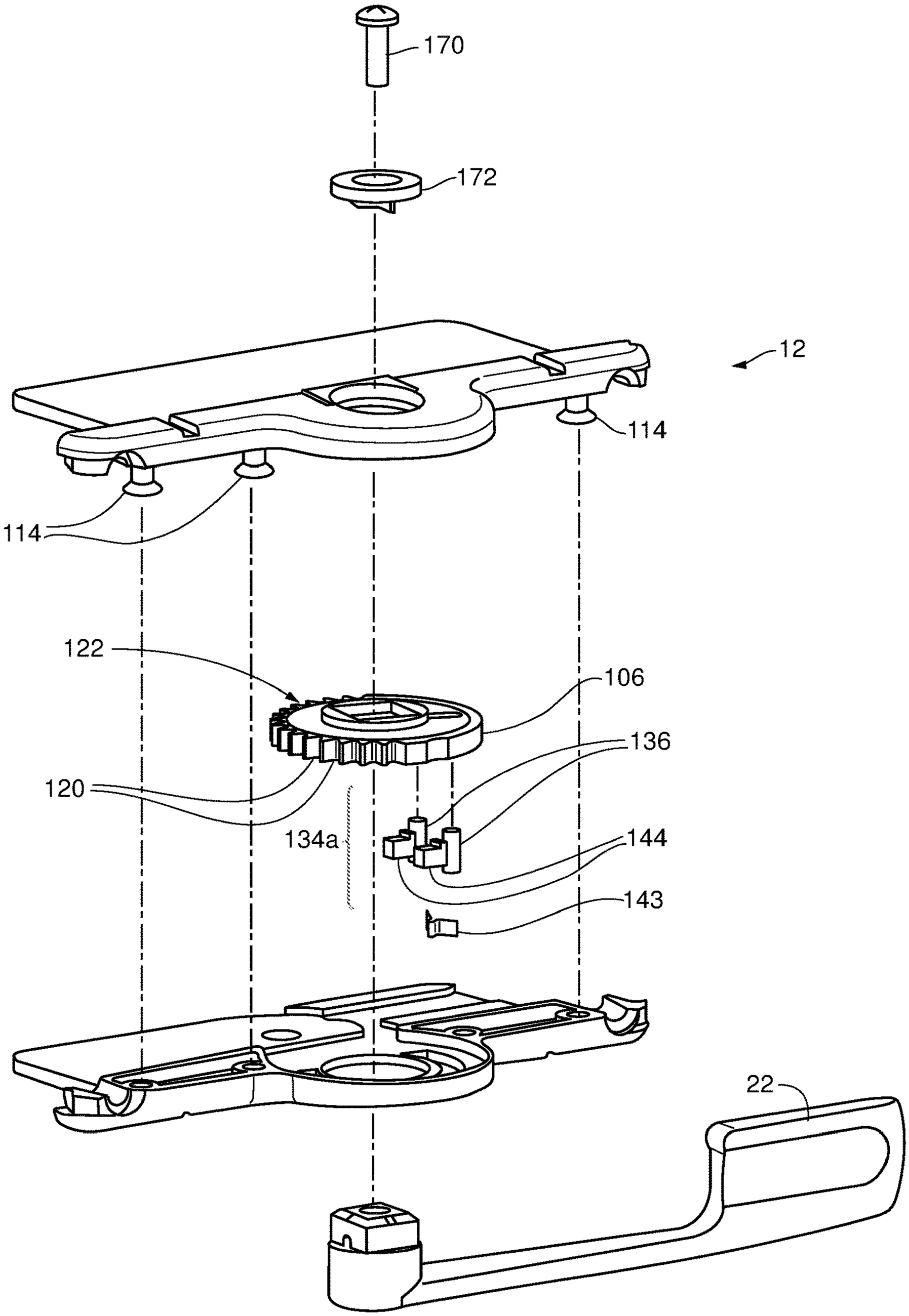

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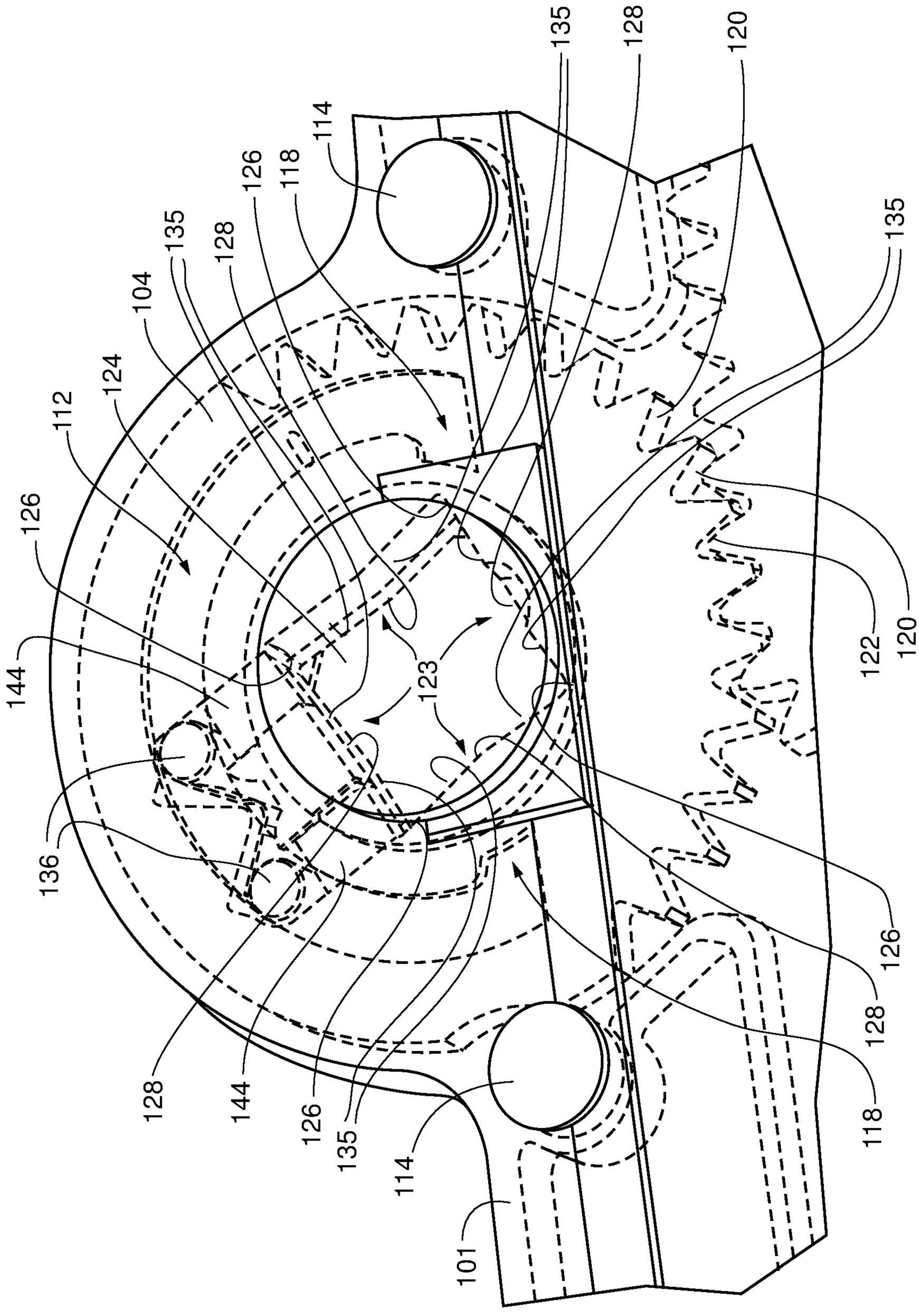
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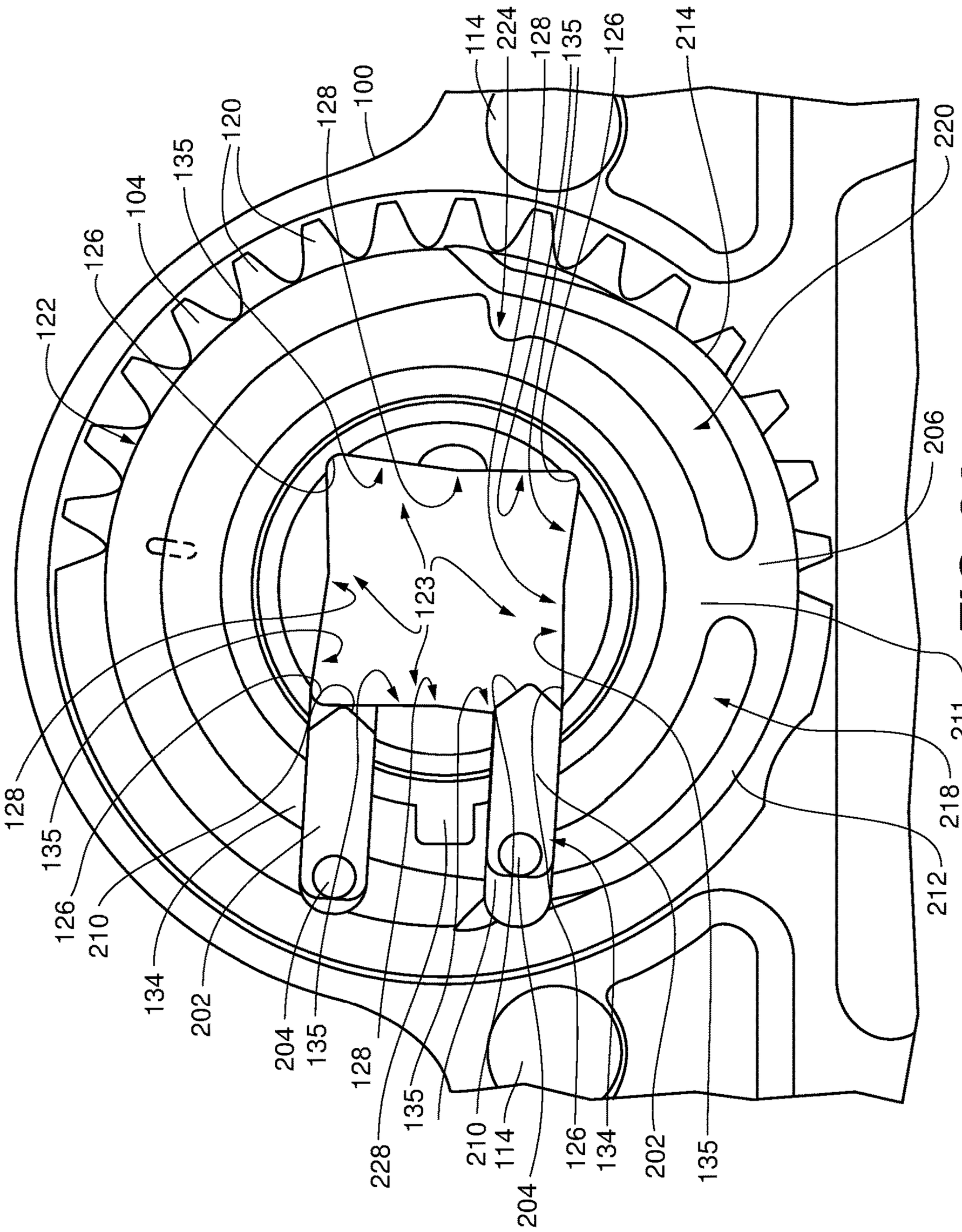
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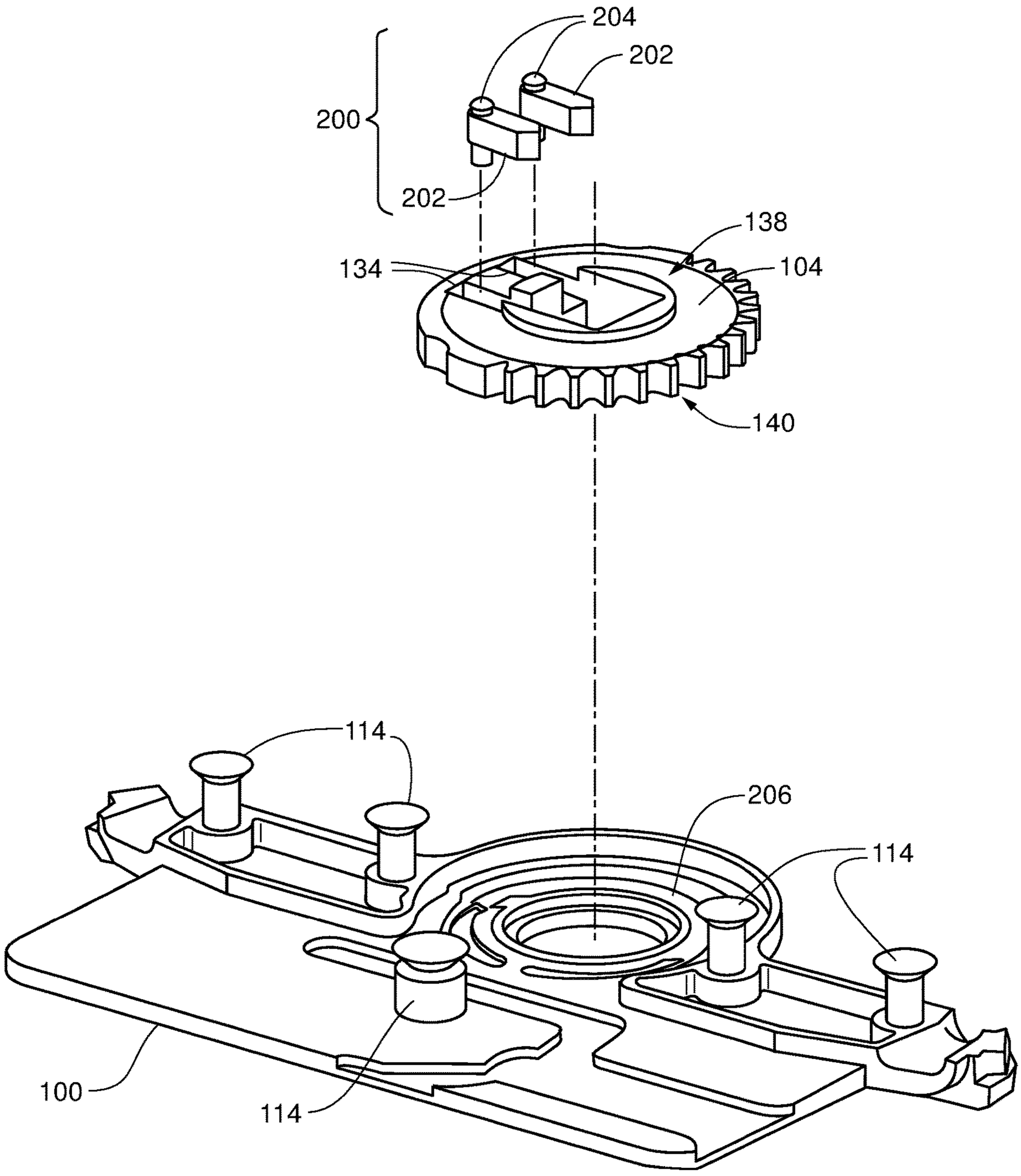
FIG. 24



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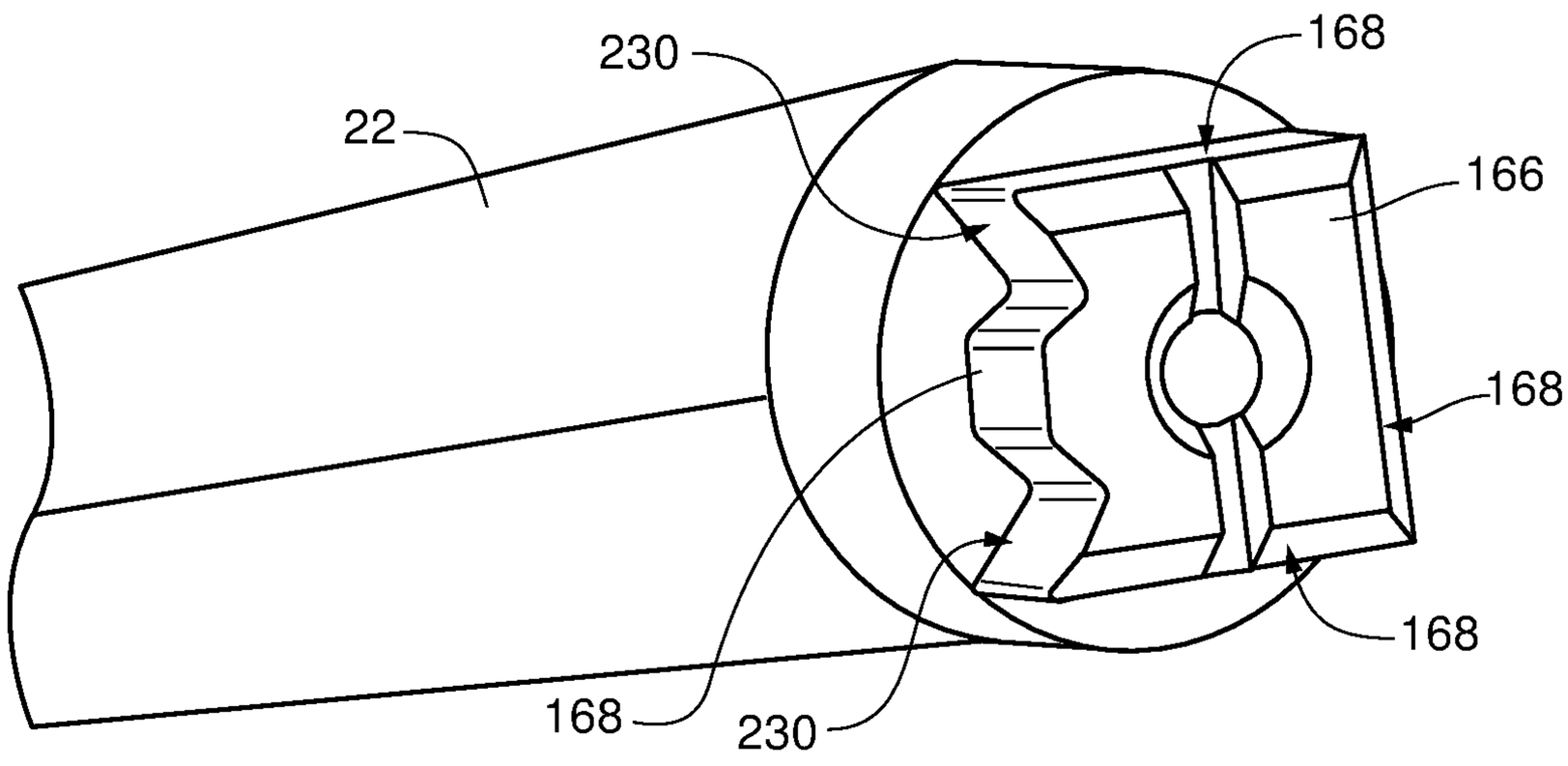

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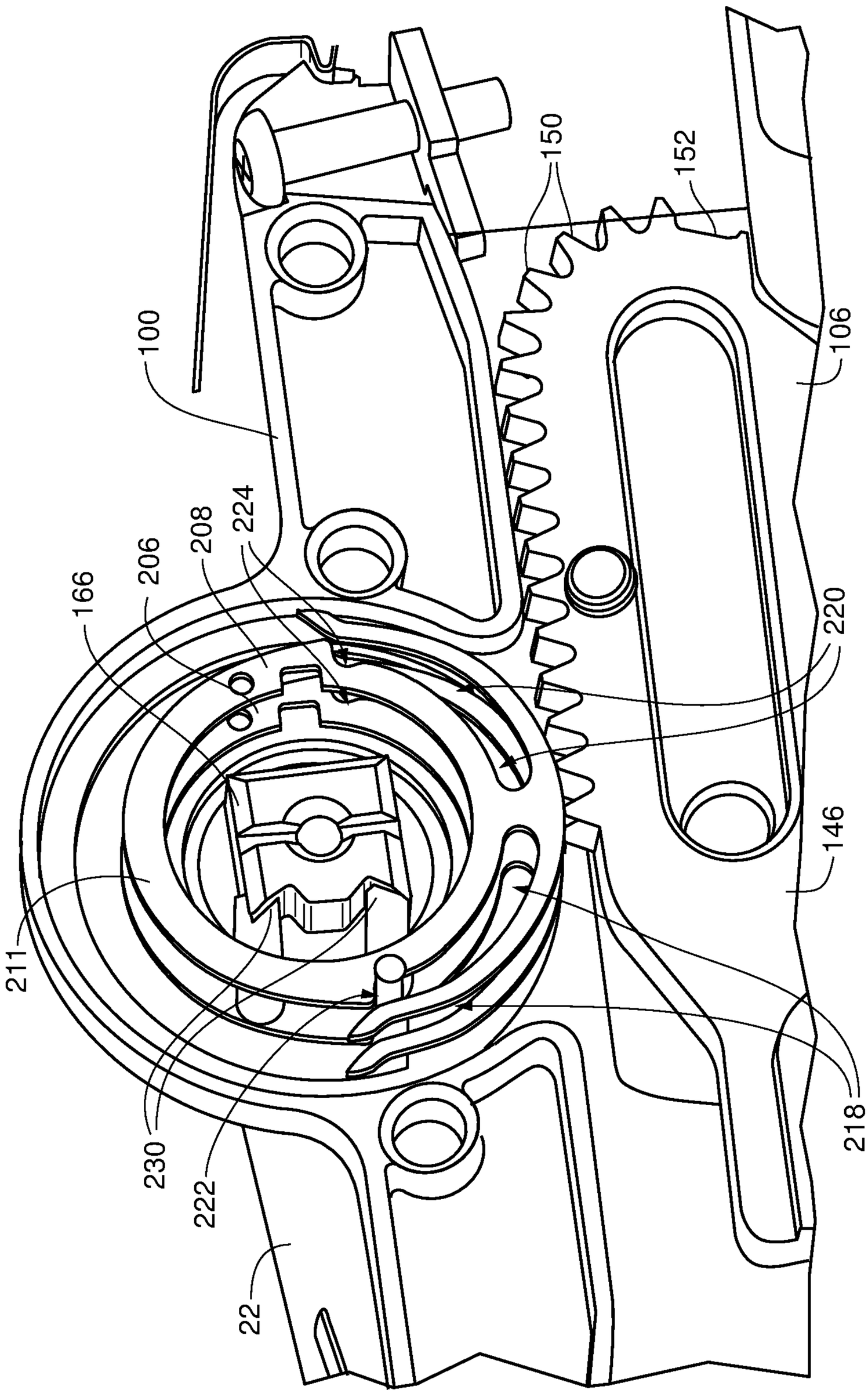

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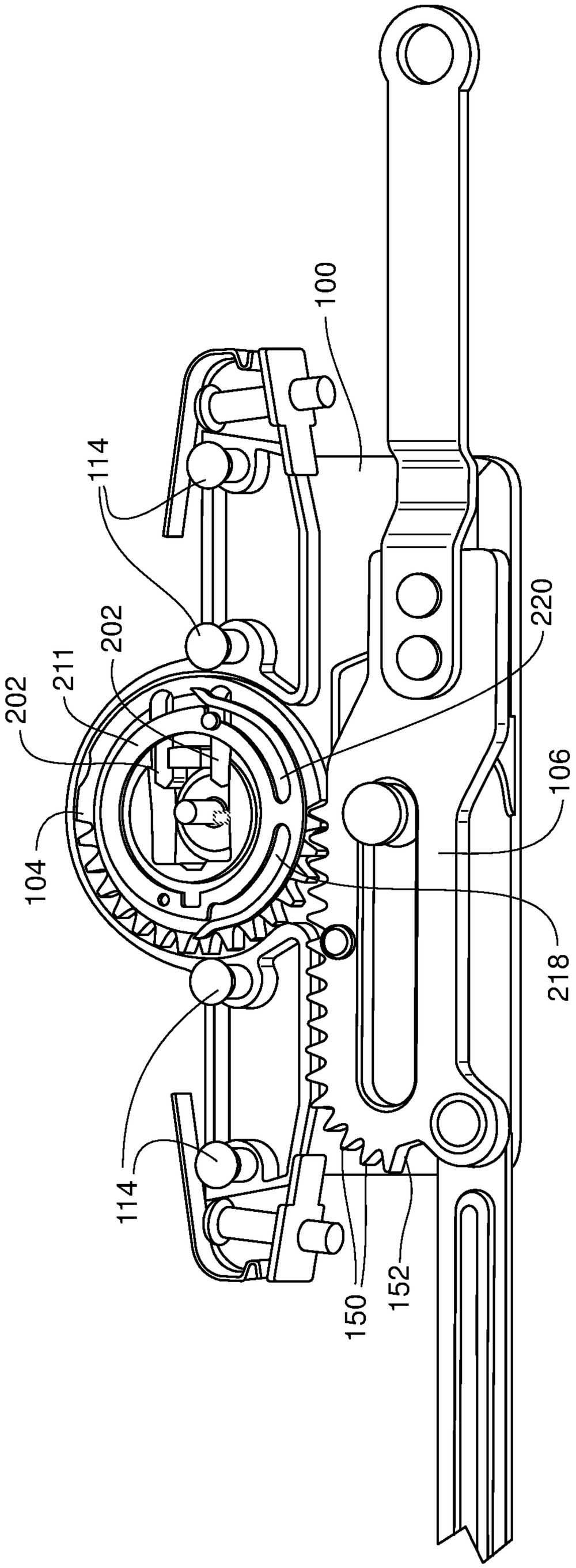

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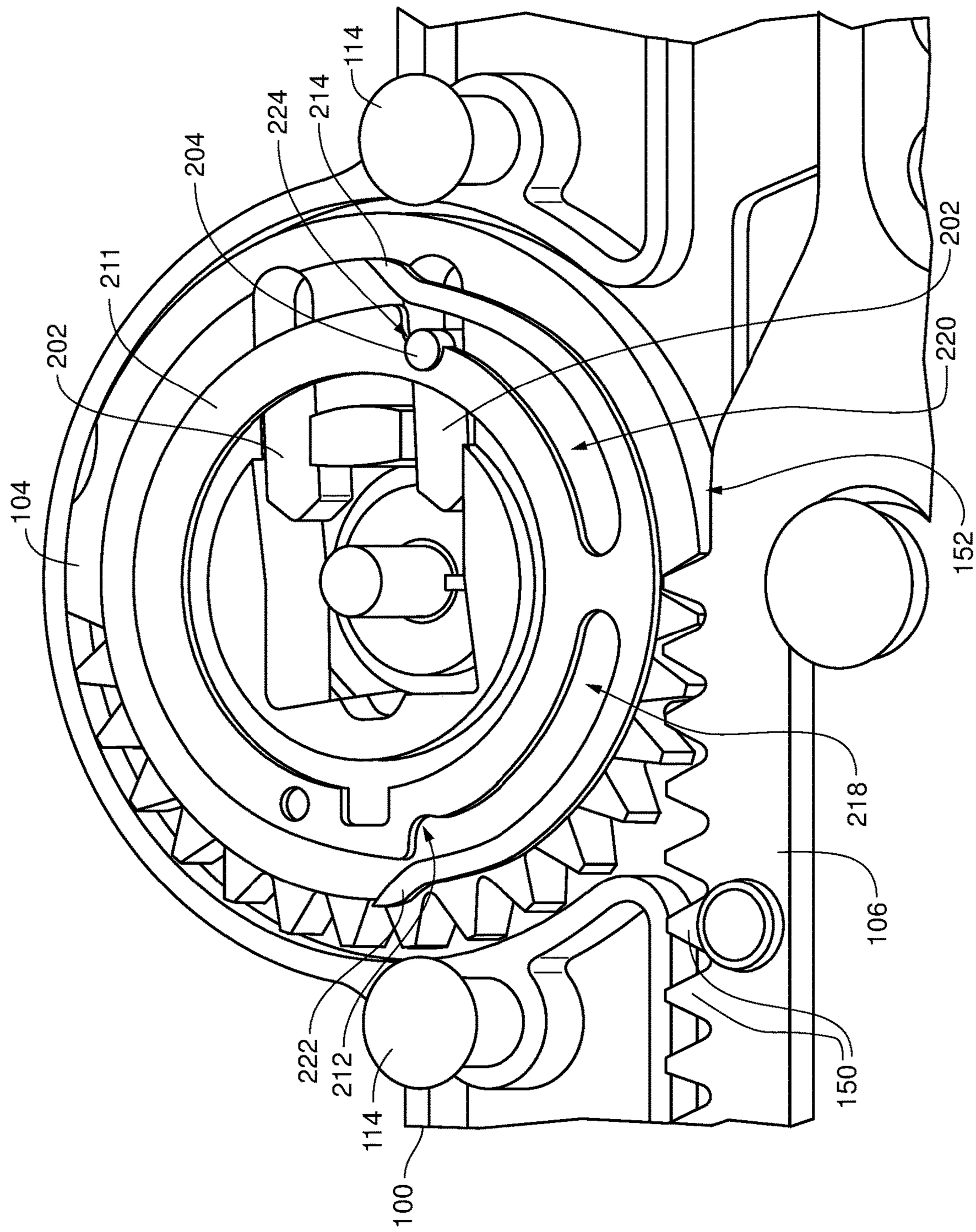
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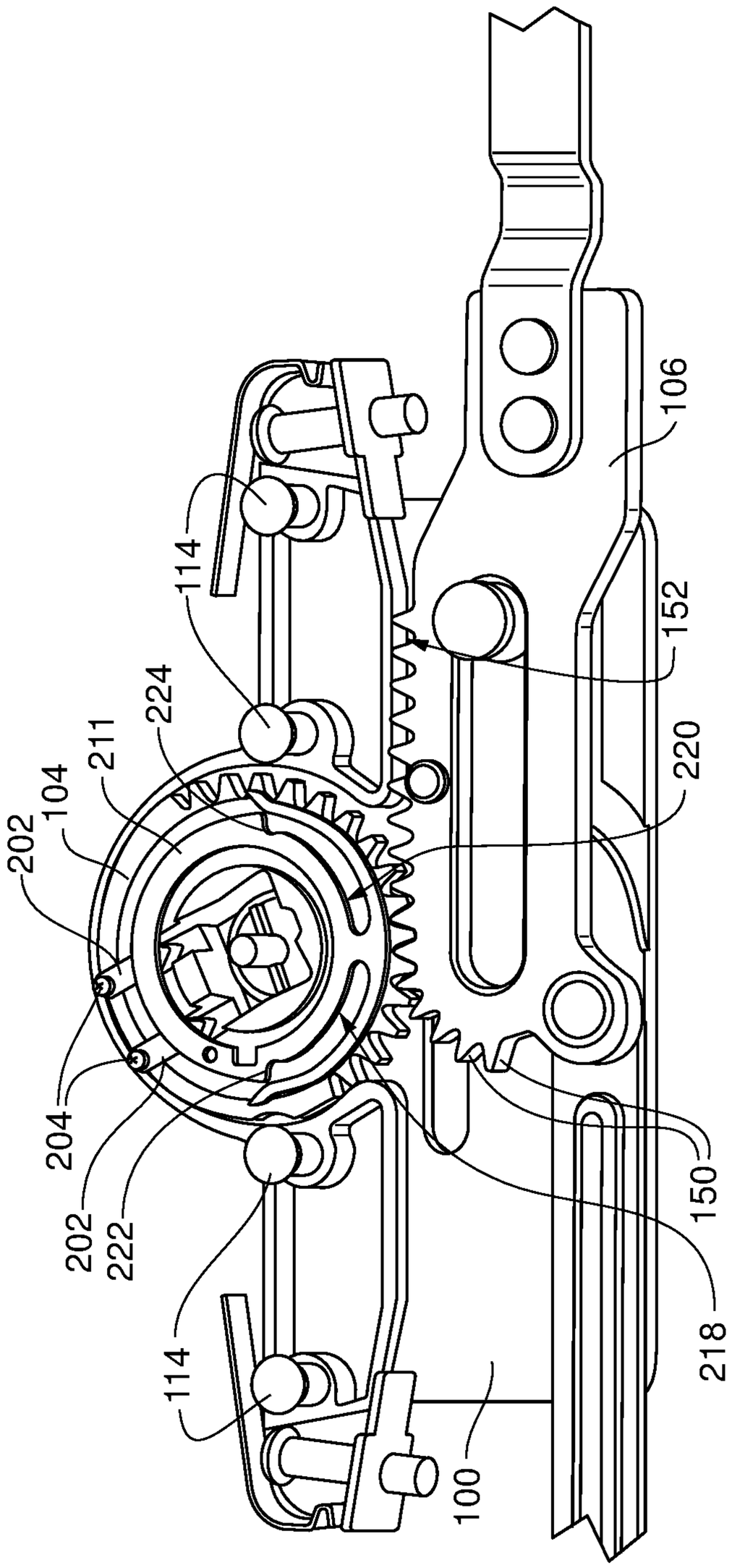
FIG. 29



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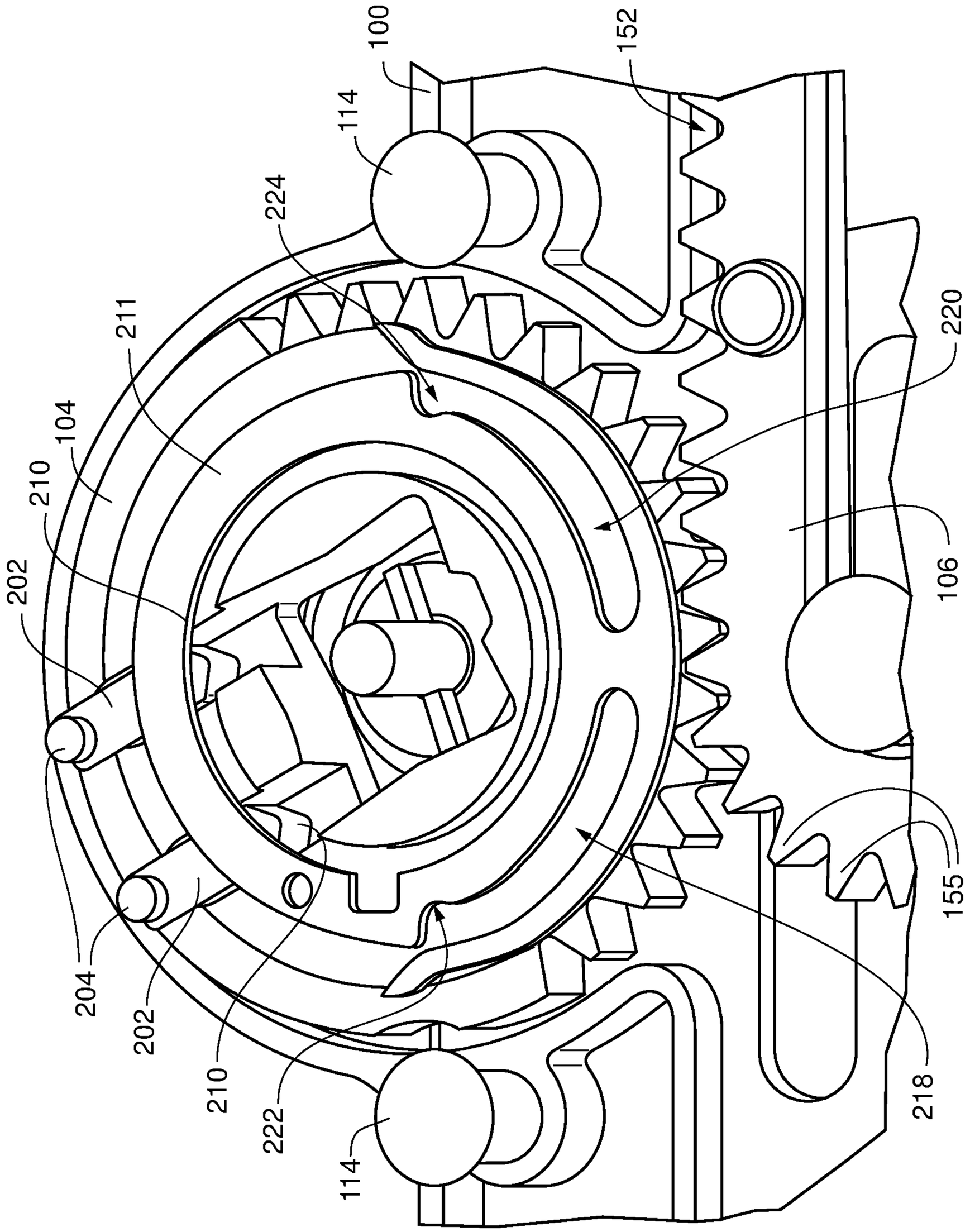
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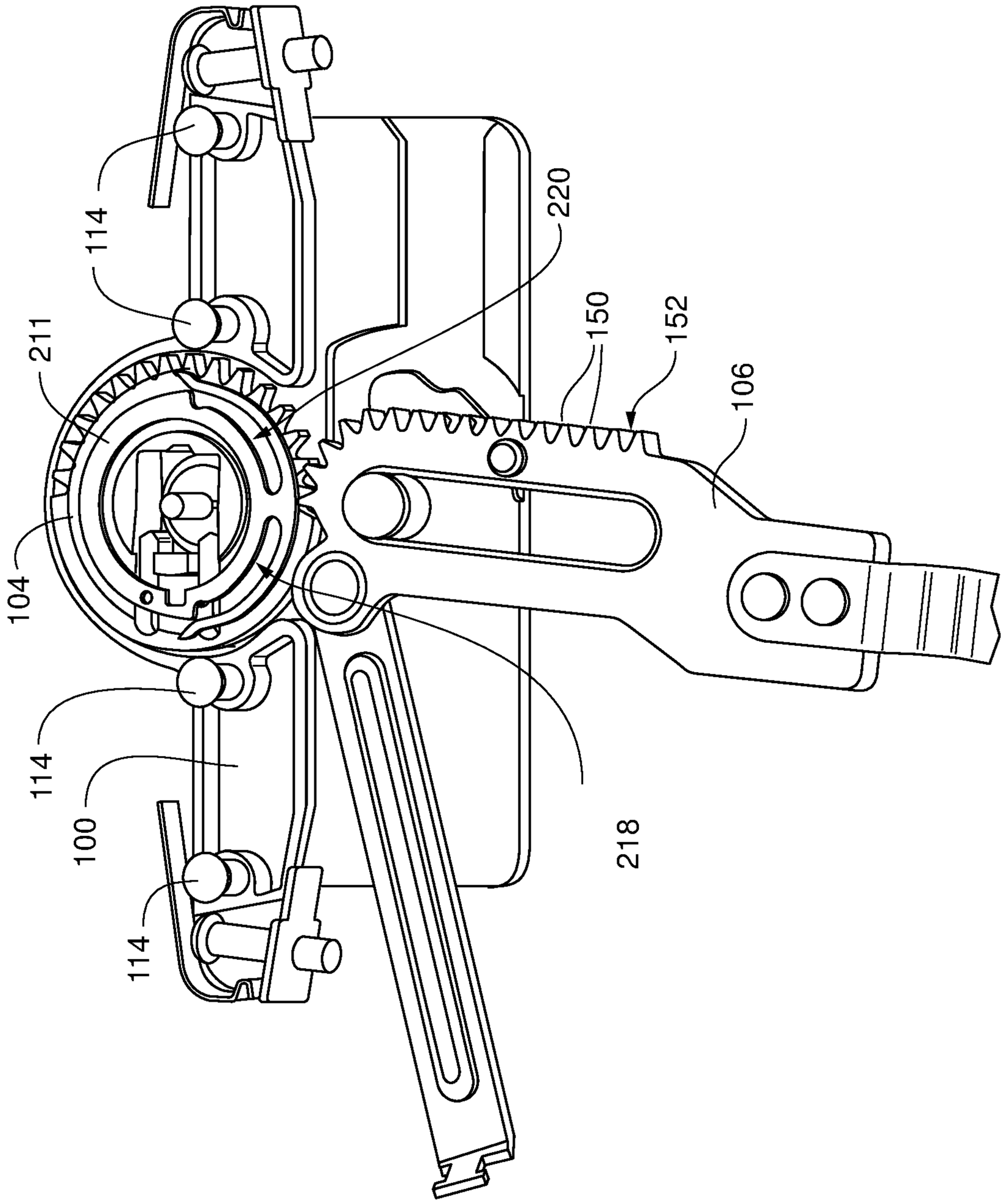

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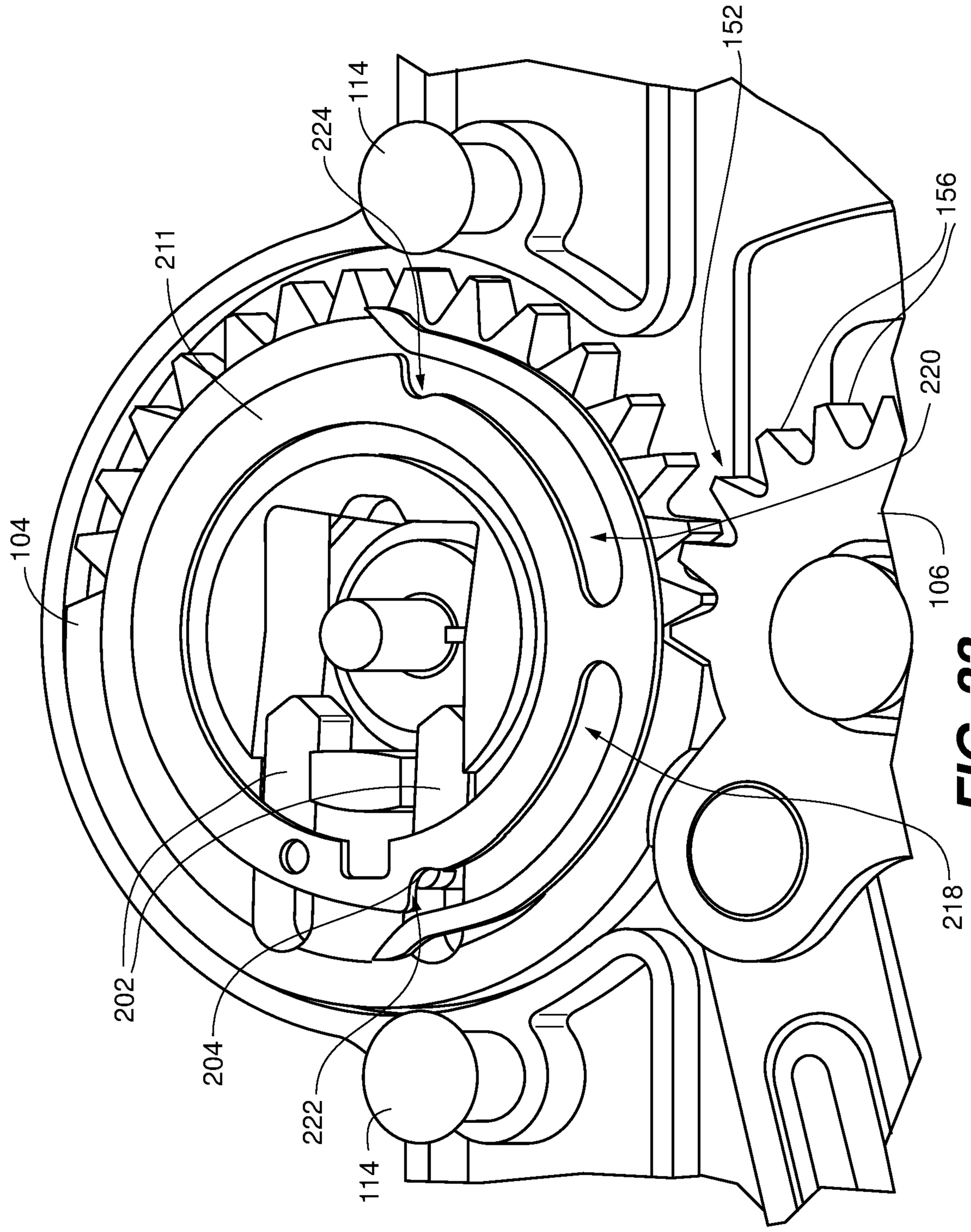

FIG. 33

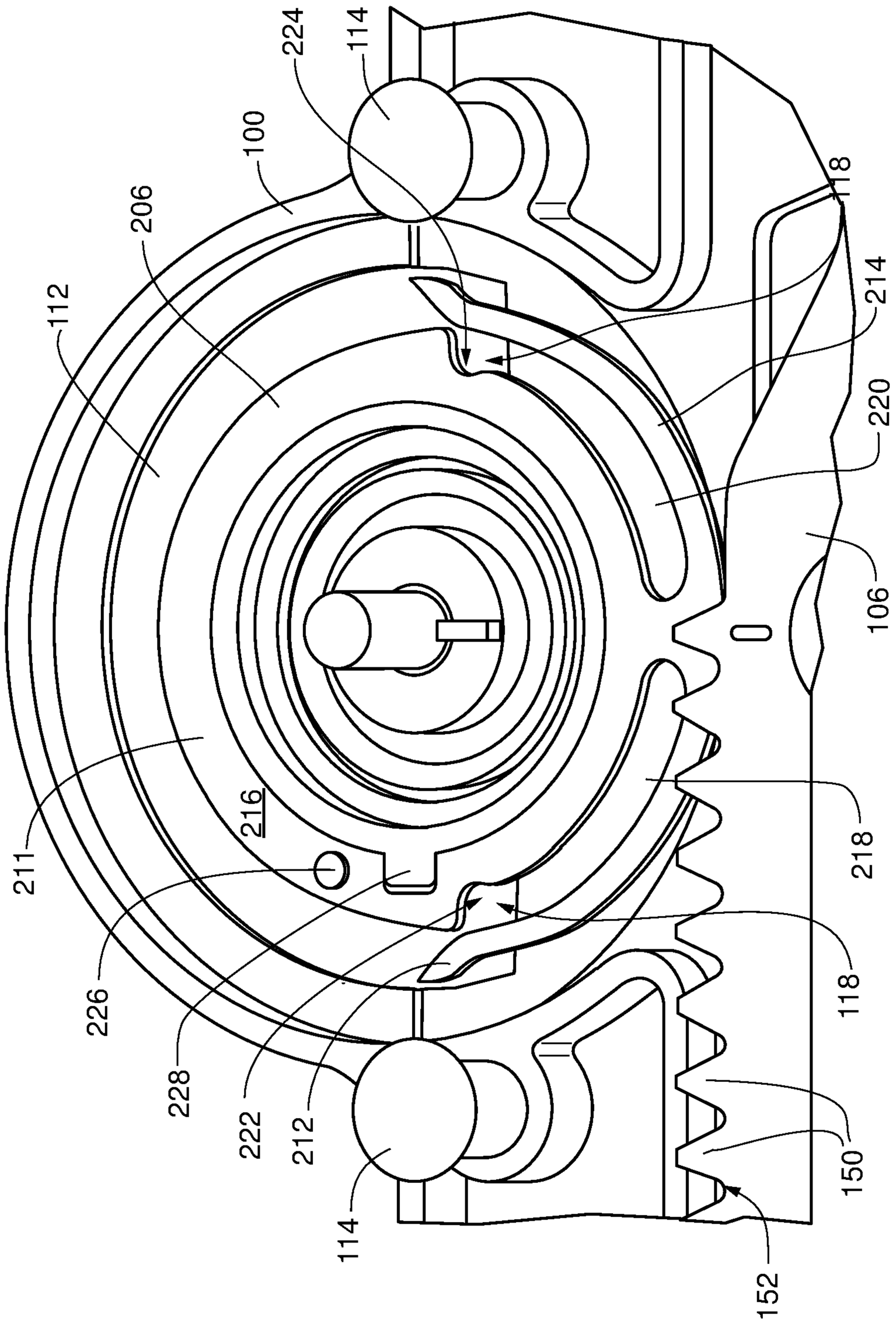
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FIG. 34

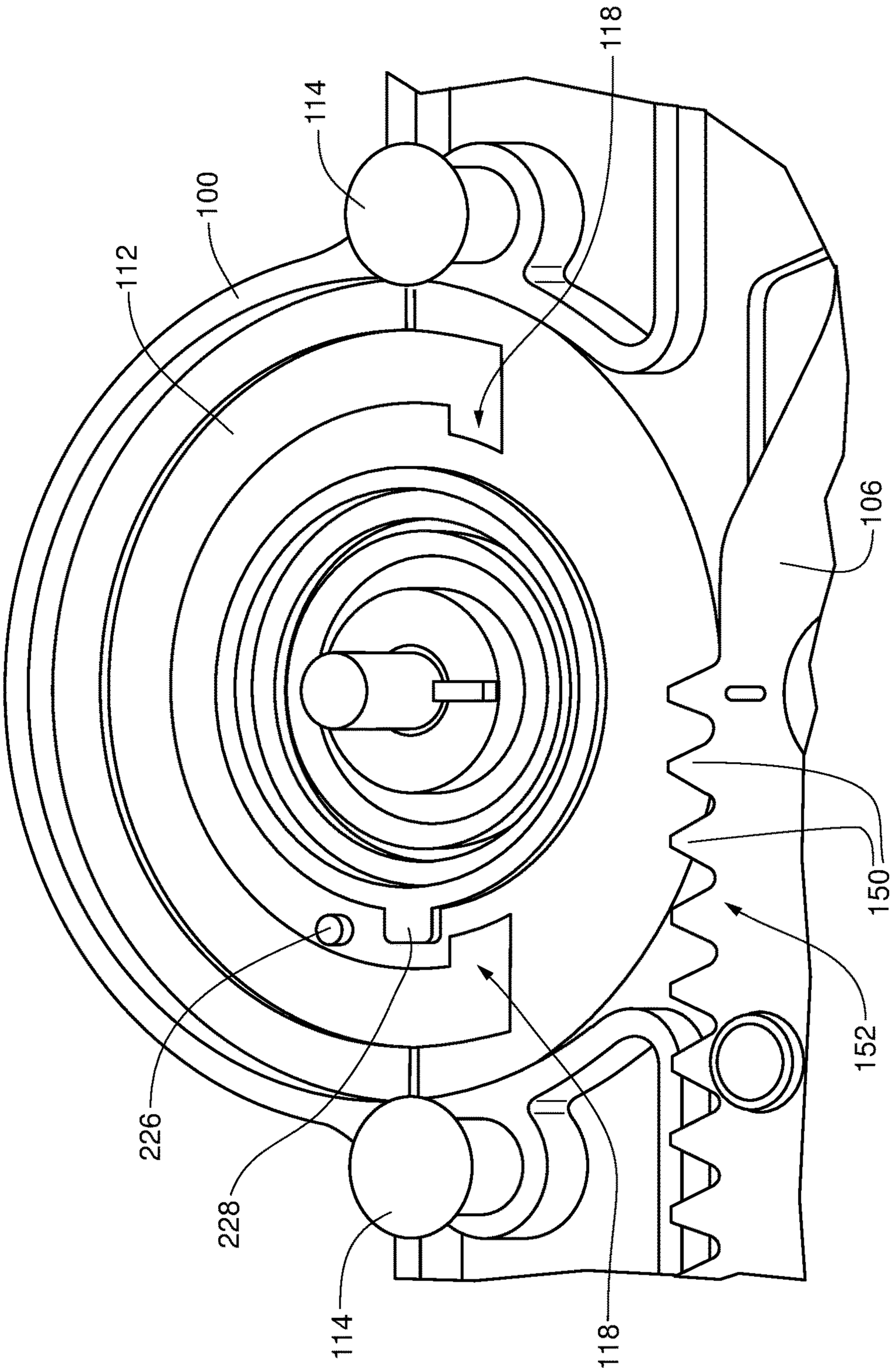

FIG. 35

INTEGRATED CASEMENT WINDOW OPERATOR AND LOCK WITH ANTI-BACKDRIVE FEATURE

CROSS-REFERENCE TO RELATED APPLICATIONS

This application claims the benefit of U.S. Provisional Patent Application No. 62/548,260, filed Aug. 21, 2017, and entitled INTEGRATED CASEMENT WINDOW OPERATOR AND LOCK WITH ANTI-BACKDRIVE FEATURE, and also claims the benefit of U.S. Provisional Patent Application No. 62/660,135, filed Apr. 19, 2018, and entitled INTEGRATED CASEMENT WINDOW OPERATOR AND LOCK WITH ANTI-BACKDRIVE FEATURE, both said applications being fully incorporated herein by reference.

TECHNICAL FIELD

The instant invention relates to casement windows, and in particular operators and locks for casement windows.

BACKGROUND

A casement window is a window that has a sash attached to a frame with hinges so that the sash can swing in and out to close or open the opening defined by the frame. Casement windows have certain advantages over sliding windows, such as double-hung or sideways sliding windows. In particular, sliding windows can be difficult to seal against air infiltration, since the sash must slide against the air sealing gasket or weather stripping. This often means that the sliding sash is not fitted as tightly, and the materials used for sealing selected so as to avoid excessive friction and wear. Casement sashes, however, can swing into contact with the seal, thereby avoiding any friction and causing minimal wear of the seal.

A drawback of casement windows, however, is that an operator typically must be used. An example of a typical operator used with a casement is disclosed in U.S. Pat. No. 7,464,619, said patent being hereby fully incorporated herein by reference. Such complex operators add expense and complexity to the window. Further, casement windows typically have separate locking systems to provide security against unauthorized access. These systems can add complexity to window operation as well as expense. These factors have led to casement windows being used less frequently in low-cost construction.

Prior attempts have been made to provide a simple integrated casement operator that incorporates both operation and locking functions in a single device. An example is the device described in. U.S. patent application Ser. No. 15/403,466, now U.S. Pat. No. 10,221,607, entitled INTEGRATED CASEMENT WINDOW OPERATOR AND LOCK, hereby fully incorporated herein by reference. Drawbacks of this device, however, are that it can be prone to back-driving thereby enabling unauthorized access through the window, and the hook arrangement for securing the locking point detracts from the aesthetic appearance of the device.

What is still needed in the industry is a simple casement operator that integrates the locking function in one device and that addresses the drawbacks identified above.

SUMMARY

Embodiments of the present invention address the need in the industry is a simple casement operator that integrates the locking function in one device and that addresses the drawbacks identified above including providing anti-backdriving features. According to an embodiment, an integrated casement window operator and lock includes a gear mechanism, the gear mechanism including a housing, a pinion gear rotatably mounted to the housing, and an arm assembly including an arm and a sash interface link. The arm defines a rack portion and an adjacent arcuate gear portion, and the arm is slidably and rotatably mounted to the housing with the pinion gear engaged with the rack portion and the arcuate gear portion. The pinion gear defines a star-shaped aperture therethrough, the star-shaped aperture defined by a plurality of inwardly facing surfaces, each of the inwardly facing surfaces comprising a pair of bearing surfaces on opposite sides of a central ridge. The gear further defines a pair of spaced-apart slots, the slots extending outwardly from a separate one of the pair of bearing surfaces of one of the inwardly facing surfaces. The housing defines an arc-shaped slot with notches at opposing ends of the arc-shaped slot.

The device further includes a pair of anti-backdrive pin assemblies, each of the anti-backdrive pin assemblies slidably disposed in a separate one of the spaced-apart slots of the gear and including an anti-backdrive pin, each of the anti-backdrive pins engaged in the arc-shaped slot. A handle defines a square-shaped shaft portion, the square-shaped shaft portion received in the star-shaped aperture of the gear, wherein the handle is selectively movable to rotate the pinion gear such that the arm is shifted between a window fully closed position and a window fully open position, wherein when the arm is in the fully closed position, the pin of a first one of the pair of anti-backdrive pin assemblies is engaged in one of the notches of the arc-shaped slot to inhibit backdriving of the arm, and when the arm is in the fully open position, the pin of a second one of the pair of anti-backdrive pin assemblies is engaged in the other one of the notches of the arc-shaped slot to inhibit backdriving of the arm. The square-shaped shaft portion of the handle is rotatable in the star-shaped aperture of the gear to shift the anti-backdrive assemblies out of engagement with the notches.

In an embodiment, at least one biasing spring is arranged to urge the anti-backdrive pins into engagement with the notches. The at least one biasing spring may be a leaf spring.

In an embodiment, a pair of biasing springs is arranged to urge the anti-backdrive pins into engagement with the notches. Each one of the pair of biasing springs may be a coil spring, or the pair of biasing springs may be formed as a portion of an actuating ring.

In an embodiment, the anti-backdrive pin assemblies may include a follower portion and a pin portion. The follower portion may have a wedge-shaped end.

In an embodiment, the square-shaped shaft portion of the handle defines four faces, one of the four faces defining a pair of spaced apart notches, the wedge-shaped ends of the follower portions being engageable in the notches in the face.

In an embodiment, a casement window includes a frame defining an opening, a sash received in the frame and hinged to the frame to selectively close the opening, and a window operator and lock. The window operator and lock includes a gear mechanism, the gear mechanism including a housing, a pinion gear rotatably mounted to the housing, and an arm assembly including an arm and a sash interface link. The arm defines a rack portion and an adjacent arcuate gear portion, and the arm is slidably and rotatably mounted to the housing with the pinion gear engaged with the rack portion and the arcuate gear portion. The pinion gear defines a star-shaped

aperture therethrough, the star-shaped aperture defined by a plurality of inwardly facing surfaces, each of the inwardly facing surfaces comprising a pair of bearing surfaces on opposite sides of a central ridge. The gear further defines a pair of spaced-apart slots, the slots extending outwardly from a separate one of the pair of bearing surfaces of one of the inwardly facing surfaces. The housing defines an arc-shaped slot with notches at opposing ends of the arc-shaped slot.

The operator further includes a pair of anti-backdrive pin assemblies, each of the anti-backdrive pin assemblies slidably disposed in a separate one of the spaced-apart slots of the gear and including an anti-backdrive pin, each of the anti-backdrive pins engaged in the arc-shaped slot. A handle defines a square-shaped shaft portion, the square-shaped shaft portion received in the star-shaped aperture of the gear, wherein the handle is selectively movable to rotate the pinion gear such that the arm is shifted between a window fully closed position and a window fully open position, wherein when the arm is in the fully closed position, the pin of a first one of the pair of anti-backdrive pin assemblies is engaged in one of the notches of the arc-shaped slot to inhibit backdriving of the arm, and when the arm is in the fully open position, the pin of a second one of the pair of anti-backdrive pin assemblies is engaged in the other one of the notches of the arc-shaped slot to inhibit backdriving of the arm. The square-shaped shaft portion of the handle is rotatable in the star-shaped aperture of the gear to shift the anti-backdrive assemblies out of engagement with the notches.

The above summary is not intended to describe each illustrated embodiment or every implementation of the subject matter hereof. The figures and the detailed description that follow more particularly exemplify various embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Subject matter hereof may be more completely understood in consideration of the following detailed description of various embodiments in connection with the accompanying figures, in which:

FIG. **1***a* depicts a casement window and integrated operator according to an embodiment of the invention;

FIG. **1** is a partial exploded view of the integrated operator depicted in FIG. **1***a;*

FIG. **2** is a side elevation view of the integrated operator depicted in FIG. **1** in a window open position;

FIG. **3** is a side elevation view of a portion of the housing of the integrated operator depicted in FIG. **1**;

FIG. **4** is a side elevation view of the integrated operator of FIG. **1** in a window closed position with the gear portion free to rotate;

FIG. **5** is a side elevation view of the integrated operator of FIG. **1** in a window closed position with the gear portion engaged with the anti-back-drive mechanism engaged to prevent rotation;

FIG. **6** a side elevation view of the gear portion of the integrated operator of FIG. **1**;

FIG. **7** is a side elevation view of the gear portion of the integrated operator of FIG. **1** with the anti-back-drive mechanism engaged to prevent rotation;

FIG. **8** is a side elevation view of the gear portion of the integrated operator of FIG. **1** with the anti-back-drive mechanism disengaged;

FIG. **9** is an isometric view of the rear side of the cover of the integrated operator of FIG. **1**;

FIG. **10** is a partial side sectional view of the cover of the integrated operator depicted in FIG. **9**;

FIG. **11** is an isometric view of the integrated operator of FIG. **1** with the cover depicted in phantom;

FIG. **12** is a partial sectional view of the integrated operator of FIG. **11** depicting the engagement of the cover with the housing;

FIG. **13** is a partial side elevation view of the integrated operator of FIG. **1** depicting the engagement of the housing with a window profile;

FIG. **14** is a partial side elevation view of the integrated operator of FIG. **1** depicting the engagement tabs of the housing in a retracted position;

FIG. **15** is a partial side elevation view of the integrated operator of FIG. **1** depicting the engagement tabs of the housing in an extended position;

FIG. **16** is a rear isometric view of the integrated operator of FIG. **1** with the engagement tabs in a retracted position;

FIG. **17** is a rear isometric view of the integrated operator of FIG. **1** with the engagement tabs in an extended position;

FIG. **18** is a partial isometric view of the integrated operator of FIG. **1** with a portion of the housing depicted in phantom to show engagement of the arm in a slot in the housing;

FIG. **19** is a partial isometric view of a portion of the housing of the integrated operator of FIG. **1**;

FIG. **20** is an isometric view of the handle assembly of the integrated operator of FIG. **1**;

FIG. **21** is a partial sectional view of the integrated operator of FIG. **1**;

FIG. **22** is an exploded view of an alternative embodiment of an integrated operator in which the anti-backdrive pins are urged by a single leaf spring;

FIG. **23** depicts the gear portion of the embodiment of FIG. **22**;

FIG. **24** is a plan view depiction of the gear portion of another alternative embodiment of the invention;

FIG. **25** is an exploded view of the embodiment of FIG. **24**;

FIG. **26** is an isometric view of the handle shaft of the embodiment of FIG. **24**

FIG. **27** is a partial isometric view of the embodiment of FIG. **24**, with the gear portion omitted to show the actuating rings of the device;

FIG. **28** is a partial isometric view of the embodiment of FIG. **24** depicted in the window closed and locked position;

FIG. **29** is a close up view of the gear portion of the mechanism depicted in FIG. **28**;

FIG. **30** is a partial isometric view of the embodiment of FIG. **24** depicted in the window closed and unlocked position;

FIG. **31** is a close up view of the gear portion of the mechanism depicted in FIG. **30**;

FIG. **32** is a partial isometric view of the embodiment of FIG. **24** depicted in the window open and secured in place by the anti-backdrive pins;

FIG. **33** is a close up view of the gear portion of the mechanism depicted in FIG. **32**;

FIG. **34** is a partial isometric view of one of the housing halves of the embodiment of FIG. **24** with the gear omitted to show the actuating ring securement to the housing half; and

FIG. **35** is a partial isometric view of one of the housing halves of the embodiment of FIG. **24** with the gear and actuating ring omitted.

While various embodiments are amenable to various modifications and alternative forms, specifics thereof have

been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the claimed inventions to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the subject matter as defined by the claims.

DETAILED DESCRIPTION OF THE DRAWINGS

In FIG. **1***a*, there is depicted a typical casement window **10** with an integrated operator and lock **12** according to an embodiment of the invention. Casement window **10** generally includes frame **14** and sash **16**. Frame **14** defines opening **18**. Sash **16** is mounted to frame **14** with hinges (not depicted), and can be selectively swung to open and close opening **18**.

Integrated operator and lock **12** is depicted in FIGS. **1-21**. Integrated operator and lock **12** generally includes gear mechanism **20**, handle **22**, and cover **24**. Gear mechanism generally includes housing **101**, comprised of housing halves **100**, **102**, pinion gear **104**, and arm assembly **106**. Housing half **100** defines channel **108** and guide pin **110**. Housing half **102** can define a channel (not depicted) corresponding to channel **108** and an aperture **109** corresponding to guide pin **110**.

Housing half **100** further defines arc-shaped channel **112**, and housing half **102** defines a corresponding arc-shaped channel (not depicted). Mating pins **114** defined by housing half **100** are received in apertures **116** in housing half **100**. Arc shaped channel **112** has notches **118** at each end.

Gear **104** defines teeth **120** along a portion of periphery **122**. Star-shaped aperture **124** is defined through the center of gear **104** by inwardly facing surfaces **123**. Referring to FIGS. **6** and **23**, corners **126** of aperture **124** are relieved, forming a central ridge **128** in each of sides **130**, **132**, of aperture **124**. Parallel slots **134** extend outwardly from aperture **124** toward periphery **122**. Bearing surfaces **135** are formed on opposite sides of central ridge **128**.

An anti-backdrive feature is provided through anti-back-drive assembly **134***a*. Anti-backdrive assembly **134***a* generally includes anti-backdrive pins **136**, biasing springs **142**, and follower blocks **144**. Anti-backdrive assemblies **134***a* are received in slots **134**, with anti-back-drive pins **136** extending outwardly from each face **138**, **140**, of gear **104**. Biasing springs **142** are provided to bias anti-back-drive pins **136** toward aperture **124**. Biasing springs **142** can be coil springs as depicted in FIG. **1**, or can be any other type of biasing element that is effective to bias pins **136**, such as leaf spring **143** depicted in FIGS. **22** and **23**. Follower blocks **144** are provided on the inner end of each slot **134** and are slidable in slots **134** with anti-back-drive pins **136**, with, or against, the bias of springs **142**. Anti-back-drive pins **136** ride in arc-shaped channel **112** of housing half **100** and/or housing half **102**.

Arm assembly **106** generally includes arm body **146** defining elongate aperture **148**. Gear teeth **150** are defined along a portion of peripheral edge **152**. Guide pin **154** extends outwardly and rides in channel **156** of housing half **100**. Guide pin **110** of housing half **100** extends through elongate aperture **148**. Arm extension **158** is fixedly coupled to arm body **146** with rivets **160**, and defines boss **162**.

Handle **22** generally includes finger grip portion **164** and square shaped shaft **166** presenting bearing faces **168**. Square shaped shaft **166** extends through star-shaped aperture **124** of gear **104** and is secured in place with screw **170** and washer **172**. It will be appreciated that bearing faces **168** contact central ridges **128**, but that the star-shape of aperture **124** enables shaft **166** to rotate slightly in each direction within aperture **124** before bearing faces **168** contact bearing surfaces **135**. In a preferred embodiment, the amount of this rotation is about 7.5 degrees.

Integrated operator and lock **12** is assembled with gear **104** rotatably received between housing halves **100**, **102**, as depicted in FIG. **1**. Anti-back-drive pins **136** are received in arc-shaped channel **112**. Arm assembly **106** is received between housing halves **100**, **102**, with guide pin **110** through elongate aperture **148** and guide pin **154** engaged in channel **156**. Gear teeth **150** are meshed with teeth **120** of gear **104**.

In use, integrated operator and lock **12** is mounted on frame **14** of window **10** with end **174** of arm extension **158** coupled to sash **16**. In a window closed and locked position as depicted in FIGS. **5**, **18**, and **21**, boss **162** of arm extension **158** is drawn into channel **108**, thereby inhibiting arm **106** from swinging outward and locking sash **16** in a closed position in frame **14**. As depicted in FIG. **7**, one of anti-back-drive pins **136** is lodged in notch **118** by the bias of spring **142**, thereby preventing rotation of gear **104** to open sash **16**, except as initiated by rotation of handle **22** as will be described below.

When handle **22** is rotated in a counter-clockwise direction as depicted in FIG. **8**, square shaped shaft **166** rotates within star-shaped aperture **124** until a bearing face **166** contacts a bearing surface **135**. Another bearing face **168** of shaft **166** bears against follower block **144** and urges anti-back-drive pin **136** out of notch **118** and into arc-shaped channel **112** against the bias of spring **142**. As handle **22** is rotated further in the counter-clockwise direction, gear **104** rotates with anti-back-drive pins **136** riding in arc-shaped channel **112**. As gear **104** rotates, arm assembly **106** is urged downwardly through the mesh of gear **104** with gear teeth **150**. Once boss **162** emerges from channel **108**, sash **16** is no longer locked within frame **14**. As handle **22** is rotated further, and gear **104** reaches curved portion **170** of arm **106**, arm **106** swings outwardly, guided by guide pin **154**, as depicted in FIG. **2**, urging sash **16** to an open position. When in the fully open position, the other of anti-back-drive pins **136** drops into the other of notches **118** urged by the other of springs **142**, thereby preventing rotation of gear **104** until handle **22** is rotated in the clockwise direction. To close sash **16**, the direction of rotation of handle **22** is reversed.

It will of course be appreciated that integrated operator and lock **12** may be mounted so as to reverse the direction of movement of arm **106** from downward to upward, and the direction of rotation of handle **22** from counter-clockwise to clockwise during the opening operation. Also, it will be appreciated that although a square handle shaft and star-shaped gear aperture are described hereinabove, the same principles and functional operation can be effected with other shapes of each. Also, auxiliary arm **178** can be coupled to arm **106** to effect operation of additional remote locking points.

Another feature of embodiments of the invention is depicted in FIGS. **13-17**. In particular, housing **101** can be mounted in hollow member frame **14** by means of mounting tabs **180**, driven by fasteners **182**. With tabs **180** in a retracted position as depicted in FIG. **14**, integrated operator and lock **12** can be inserted through an aperture cut in a hollow frame member. Once in place, fasteners **182** are tightened as depicted in FIG. **15**, simultaneously extending and moving tabs **180** upward so as to clamp a wall **184** of hollow frame **14** between tab **180** and flange **186**, thereby securing housing **101** in place. This feature increases the

number of window profiles which the integrated operator and lock **12** will fit, from single wall aluminum profiles to vinyl profiles that have two walls that are spaced apart.

In FIGS. **9-12** a further feature of embodiments of the invention is depicted. In particular, snap-on cover **190** can be provided which has spring hooks **192**. Spring hooks **192** can engage with notches **194** to enable cover **24** to snap on and off housing **101**.

A further embodiment including an alternative anti-back-drive arrangement is depicted in FIGS. **24-35**. In this embodiment, anti-backdrive assemblies **200** generally include follower blocks **202**, anti-backdrive pins **204**, and actuator rings **206**, **208**. Follower blocks **202** have wedge-shaped ends **210**, and anti-backdrive pins **204** are carried in the opposite end of follower blocks **202**. As described for the embodiments above, anti-backdrive assemblies **200** are received in slots **134** of gear **104**, with anti-back-drive pins **204** extending outwardly from each face **138**, **140**, of gear **104** and riding in arc-shaped channel **112** of housing half **100** and/or housing half **102**.

As best depicted in FIGS. **34** and **35**, actuator rings **206**, **208**, generally include circular body portion **211**, which defines a pair of opposing leaf spring arms **212**, **214**. Between each spring arm **212**, **214**, and inner body portion **216** are slots **218**, **220**, respectively with notches **222**, **224**, defined at the outer ends of the slots. Each actuator ring **206**, **208**, is fixed in rotational position relative to a respective housing half **100**, **102**, with boss **226** and indexing key **228**.

In this embodiment, as depicted in FIGS. **26** and **27**, square-shaped shaft **166** of handle **22** has notches **230** defined in one of bearing faces **168**. Notches **230** are shaped to receive wedge-shaped ends **210** of follower blocks **202**, and to facilitate shifting of follower blocks **202** as further described below.

In use, with the integrated operator in the closed and locked position as depicted in FIGS. **28** and **29**, spring arm **214** urges one of the anti-backdrive pins **204** into notches **224** and **118**, thereby engaging wedge-shaped end **210** of the coupled follower block **202** into one of the notches **230** in square-shaped shaft **166** of handle **22**. In this position, arm assembly **106** cannot be back-driven to rotate handle **22**, and thereby unlock and open the window, since the anti-back-drive pin **204** is held in both notches **224** and **118** against rotation and is urged into engagement therewith by spring arm **214**.

From this position, as depicted in FIGS. **30** and **31**, when handle **22** is rotated counter-clockwise relative to the figures, wedge-shaped end **210** slides along the tapered surfaces of notch **230**, thereby urging follower block **202** outward against the bias of spring arm **214**. Accordingly, anti-backdrive pin **204** is shifted out of engagement with notches **224** and **118** and into arc-shaped channel **112**, where the handle and mechanism can be freely shifted in either direction with handle **22**.

As depicted in FIGS. **32** and **33**, further counter-clockwise rotation of handle **22** will cause arm assembly **106** to swing outward, thereby opening sash **16** of casement window **10**, and will cause the other of anti-backdrive pins **204** to contact and thereby be guided and urged by spring arm **212** into engagement with notch **222** and notch **118** at the other end of arc-shaped channel **112**. In this position, arm assembly **106** cannot be back-driven by wind or other forces to rotate handle **22**, since the anti-backdrive pin **204** is held in both notches **222** and **118** and is urged into engagement therewith by spring arm **212**. When it is desired to close casement window **10**, handle **22** can be rotated clockwise, thereby reversing the sequence described above.

Advantages of various embodiments of the invention can be as follows:

- A positive detent provided by the anti-backdrive pin assemblies in the window open and closed positions can provide an audible click when the operator is in the fully open position and in the fully closed and locked position.
- The anti-backdriving feature can prevent wind buffeting from slamming the window shut when the device is in the fully open position.
- The described mounting method enables the operator to be applied to a wide variety of window profiles.
- The described mounting method enables screws to be driven into a window from the same side as the operator is installed in the cut out.
- The described mounting method enables access to the screw heads in the case of a hardware failure where the window has become stuck shut without cutting into the window frame profile.
- The lock-up feature within the body of the operator rather than a hook on the gear arm and lug on bracket reduces chance of the keeper missing the securing lug.
- The lock-up feature within the body of the operator rather than the hook on the gear arm and lug on bracket means operator fits wider variety of window profiles.
- The cover and handle can be removable for easy change of aesthetics, and the cover can snap on and off without tools.
- Handle is screwed on using standard fastener which holds the handle tighter, with less slop, than a spring.
- The anti-backdrive feature works in both directions. It prevents unauthorized entry in the locked position and also keeps the window from slamming shut in the open position, as for example due to wind.

Various embodiments of systems, devices, and methods have been described herein. These embodiments are given only by way of example and are not intended to limit the scope of the claimed inventions. It should be appreciated, moreover, that the various features of the embodiments that have been described may be combined in various ways to produce numerous additional embodiments. Moreover, while various materials, dimensions, shapes, configurations and locations, etc. have been described for use with disclosed embodiments, others besides those disclosed may be utilized without exceeding the scope of the claimed inventions.

Persons of ordinary skill in the relevant arts will recognize that the subject matter hereof may comprise fewer features than illustrated in any individual embodiment described above. The embodiments described herein are not meant to be an exhaustive presentation of the ways in which the various features of the subject matter hereof may be combined. Accordingly, the embodiments are not mutually exclusive combinations of features; rather, the various embodiments can comprise a combination of different individual features selected from different individual embodiments, as understood by persons of ordinary skill in the art. Moreover, elements described with respect to one embodiment can be implemented in other embodiments even when not described in such embodiments unless otherwise noted.

Although a dependent claim may refer in the claims to a specific combination with one or more other claims, other embodiments can also include a combination of the dependent claim with the subject matter of each other dependent claim or a combination of one or more features with other

dependent or independent claims. Such combinations are proposed herein unless it is stated that a specific combination is not intended.

Any incorporation by reference of documents above is limited such that no subject matter is incorporated that is contrary to the explicit disclosure herein. Any incorporation by reference of documents above is further limited such that no claims included in the documents are incorporated by reference herein. Any incorporation by reference of documents above is yet further limited such that any definitions provided in the documents are not incorporated by reference herein unless expressly included herein.

For purposes of interpreting the claims, it is expressly intended that the provisions of 35 U.S.C. § 112(f) are not to be invoked unless the specific terms "means for" or "step for" are recited in a claim.

The invention claimed is:

1. An integrated casement window operator and lock, comprising:

a gear mechanism, the gear mechanism including a housing, a pinion gear rotatably mounted to the housing, and an arm assembly including an arm and a sash interface link, the arm defining a rack portion and an adjacent arcuate gear portion, the arm slidably and rotatably mounted to the housing with the pinion gear engaged with the rack portion and the arcuate gear portion, the pinion gear defining a star-shaped aperture therethrough, the star-shaped aperture defined by a plurality of inwardly facing surfaces, each of the inwardly facing surfaces comprising a pair of bearing surfaces, on opposite sides of a central ridge, the pinion gear further defining a pair of spaced-apart slots, the slots extending outwardly from a separate one of the pair of hearing surfaces of one of the inwardly facing surfaces, the housing defining an arc-shaped slot with notches at opposing ends of the arc-shaped slot;

a pair of anti-backdrive pin assemblies, each of the anti-backdrive pin assemblies slidably disposed in a separate one of the spaced-apart slots of the pinion gear and including an anti-backdrive pin, each of the anti-backdrive pins engaged in the arc-shaped slot; and

a handle defining a square-shaped shaft portion, the square-shaped shaft portion received in the star-shaped aperture of the pinion gear, wherein the handle is selectively movable to rotate the pinion gear such that the arm is shifted between a window fully closed position and a window fully open position, wherein when the arm is in the fully closed position, the pin of a first one of the pair of anti-backdrive pin assemblies is engaged in one of the notches of the arc-shaped slot to inhibit backdriving of the arm, and when the arm is in the fully open position, the pin of a second one of the pair of anti-backdrive pin assemblies is engaged in the other one of the notches of the arc-shaped slot to inhibit backdriving of the arm, the square-shaped shaft portion of the handle being rotatable in the star-shaped aperture of the pinion gear to shift the anti-backdrive assemblies out of engagement with the notches.

2. The integrated casement window operator and lock of claim **1**, further comprising at least one biasing spring arranged to urge the anti-backdrive pins into engagement with the notches.

3. The integrated casement window operator and lock of claim **2**, wherein the at least one biasing spring comprises a leaf spring.

4. The integrated casement window operator and lock of claim **1**, further comprising a pair of biasing springs arranged to urge the anti-backdrive pins into engagement with the notches.

5. The integrated casement window operator and lock of claim **4**, wherein each one of the pair of biasing springs comprises a coil spring.

6. The integrated casement window operator and lock of claim **4**, wherein the pair of biasing springs are formed as a portion of an actuating ring.

7. The integrated casement window operator and lock of claim **1**, wherein the anti-backdrive pin assemblies comprise a follower portion and a pin portion.

8. The integrated casement window operator and lock of claim **7**, wherein the follower portion defines a wedge-shaped end.

9. The integrated casement window operator and lock of claim **8**, wherein the square-shaped shaft portion of the handle defines four faces, one of the four faces defining a pair of spaced apart notches, the wedge-shaped ends of the follower portions being engageable in the notches in the face.

10. The integrated casement window operator and lock of claim **1**, further comprising a cover.

11. A casement window, comprising:

a frame defining an opening;

a sash received in the frame and hinged to the frame to selectively close the opening; and

a window operator and lock, the window operator and lock comprising:

a gear mechanism, the gear mechanism including a housing, a pinion gear rotatably mounted to the housing, and an arm assembly including an arm and a sash interface link, the arm defining a rack portion and an adjacent arcuate gear portion, the arm slidably and rotatably mounted to the housing with the pinion gear engaged with the rack portion and the arcuate gear portion, the pinion gear defining a star-shaped aperture therethrough, the star-shaped aperture defined by a plurality of inwardly facing surfaces, each of the inwardly facing surfaces comprising a pair of bearing surfaces on opposite sides of a central ridge, the pinion gear further defining a pair of spaced-apart slots, the slots extending, outwardly from a separate one of the pair of bearing surfaces of one of the inwardly facing surfaces, the housing defining an arc-shaped slot with notches at opposing ends of the arc-shaped slot;

a pair of anti-backdrive pin assemblies, each of the anti-backdrive pin assemblies slidably disposed in a separate cane of the spaced-apart slots of the pinion gear and including an anti-backdrive pin, each of the anti-backdrive pins engaged in the arc-shaped slot; and

a handle defining a square-shaped shaft portion, the square-shaped shaft portion received in the star-shaped aperture of the pinion gear, wherein the handle is selectively movable to rotate the pinion gear such that the arm is shifted between a window fully closed position and a window fully open position, wherein when the arm is in the fully closed position, the pin of a first one of the pair of anti-backdrive pin assemblies is engaged in one of the notches of the arc-shaped slot to inhibit backdriving of the arm, and when the arm is in the fully open position, the pin of a second one of the pair of anti-backdrive pin assemblies is engaged in the other

one of the notches of the arc-shaped slot to inhibit backdriving of the arm, the square-shaped shaft portion of the handle being rotatable in the star-shaped aperture of the pinion gear to shift the anti-backdrive assemblies out of engagement with the notches.

12. The casement window of claim **11**, further comprising at least one biasing spring arranged to urge the anti-backdrive pins into engagement with the notches.

13. The casement window of claim **12**, wherein the at least one biasing spring comprises a leaf spring.

14. The casement window of claim **11**, further comprising a pair of biasing springs arranged to urge the anti-backdrive pins into engagement with the notches.

15. The casement window of claim **14**, wherein each one of the pair of biasing springs comprises a coil spring.

16. The casement window of claim **14**, wherein the pair of biasing springs are formed as a portion of an actuating ring.

17. The casement window of claim **11**, wherein the anti-backdrive pin assemblies comprise a follower portion and a pin portion.

18. The casement window of claim **17**, wherein the follower portion defines a wedge-shaped end.

19. The casement window of claim **18**, wherein the square-shaped shaft portion of the handle defines four faces, one of the four faces defining a pair of spaced apart notches, the wedge-shaped ends of the follower portions being engageable in the notches in the face.

20. The casement window of claim **11**, further comprising a cover.

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